



# Psychology

ISSN: 2152-7180 Vol.1, No.3, August 2010



ISSN: 2152-7180



# Journal Editorial Board

ISSN Print: 2152-7180 ISSN Online: 2152-7199

<http://www.scirp.org/journal/psych>

---

## Editor-in-Chief

**Dr. Martin Drapeau**

McGill University, Canada

## Editorial Board

**Prof. Hamid Reza Alavi**

Shahid Bahonar University of Kerman-Iran, Iran

**Prof. Brien K. Ashdown**

University of Alaska Fairbanks, USA

**Dr. Yoram Bar-Tal**

Tel-Aviv University, Israel

**Dr. Adital Ben-Ari**

University of Haifa, Israel

**Dr. Sefa Bulut**

Abant Izzet Baysal University, Turkey

**Dr. Joshua Fogel**

Brooklyn College of the City University of New York, USA

**Dr. Thomas Vincent Frederick**

Hope International University, USA

**Prof. Jay Friedenber**

Manhattan College, USA

**Dr. George Kyriacou Georgiou**

University of Alberta, Canada

**Dr. Gary S. Goldstein**

University of New Hampshire, USA

**Dr. David M. Goodman**

Harvard Medical School, USA

**Dr. Giovanni Laviola**

Italian National Institute of Health, Italy

**Prof. Christoph Luetge**

Braunschweig University of Technology, Germany

**Prof. Katerina Maniadaki**

Technological Educational Institution, Greece

**Prof. Tim F. McLaughlin**

Gonzaga University, USA

**Prof. Etienne Mullet**

Institute of Advanced Studies (EPHE), France

**Dr. Ora Nakash**

Interdisciplinary Center (IDC) Herzliya, Israel

**Prof. Alan D. Schmetzer**

Indiana University School of Medicine, USA

**Dr. So-Jung Seo**

Kyung Hee University, Korea (South)

**Prof. Jeff Sigafos**

Victoria University of Wellington, New-zealand

**Prof. Tuomo Antero Takala**

University of Jyväskylä, Finland

**Dr. Massimiliano Versace**

Boston University, USA

**Prof. Edda Weigand**

University of Muenster, Germany

**Dr. George I. Whitehead**

Salisbury University, USA

**Dr. Patricia Gail Williams**

University of Louisville, USA

**Prof. Berney J. Wilkinson**

Clinician at Kindelan and Associates, USA

**Dr. Hui-Ching Wu**

National Taiwan University, Taiwan (China)

---

## Editorial Assistant

**Yanna Li**

Scientific Research Publishing, USA

## TABLE OF CONTENTS

Volume 1    Number 3

August 2010

<b>Positive Development in Children and the Precursors of Healthy Life-Styles: The Role of Eating Regularity and Level of Leisure Activity</b>	
S. Ciairano, G. Bardaglio, E. Rabaglietti, M. F. Vacirca.....	151
<b>“Fun, Fun, Fun”: Types of Fun, Attitudes to Fun, and their Relation to Personality and Biographical Factors</b>	
I. C. McManus, A. Furnham.....	159
<b>Life Events and Psychoeducation in Patients with Systemic Sclerosis</b>	
Y. Chen, J. Z. Huang, Y. Qiang, M. M. Han, S. C. Liu, C. L. Cui.....	169
<b>Breakup Distress and Loss of Intimacy in University Students</b>	
T. Field, M. Diego, M. Pelaez, O. Deeds, J. Delgado.....	173
<b>Communicating (and Responding to) Sexual Health Status: Reasons for STD (Non) Disclosure</b>	
T. M. Emmers-Sommer, K. M. Warber, S. Passalacqua, A. Luciano.....	178
<b>Mapping the Self with Units of Culture</b>	
L. H. Robertson.....	185
<b>Using Generalizability Theory to Evaluate the Applicability of a Serial Bayes Model in Estimating the Positive Predictive Value of Multiple Psychological or Medical Tests</b>	
C. D. Kreiter.....	194
<b>Tolerance of the ERP Signatures of Unfamiliar versus Familiar Face Perception to Spatial Quantization of Facial Images</b>	
L. Hanso, T. Bachmann, C. Murd.....	199
<b>Is a Divergent Central Serotonergic Activity Responsible for Either Despair or Learning Behavior in Intact Wistar or Sprague-Dawley CD Rats, Respectively? A Concomitant Behavioral and Electrochemical Analysis</b>	
F. Crespi.....	209
<b>Middle Ear Effusion, Attention, and the Development of Child Behavior Problems</b>	
J. Cross, D. L. Johnson, P. Swank, C. D. Baldwin, D. McCormick.....	220

# **Psychology (PSYCH)**

## **Journal Information**

### **SUBSCRIPTIONS**

The *Psychology* (Online at Scientific Research Publishing, [www.SciRP.org](http://www.SciRP.org)) is published bi-monthly by Scientific Research Publishing, Inc., USA.

#### **Subscription rates:**

Print: \$50 per issue.

To subscribe, please contact Journals Subscriptions Department, E-mail: [sub@scirp.org](mailto:sub@scirp.org)

### **SERVICES**

#### **Advertisements**

Advertisement Sales Department, E-mail: [service@scirp.org](mailto:service@scirp.org)

#### **Reprints (minimum quantity 100 copies)**

Reprints Co-ordinator, Scientific Research Publishing, Inc., USA.

E-mail: [sub@scirp.org](mailto:sub@scirp.org)

### **COPYRIGHT**

Copyright©2010 Scientific Research Publishing, Inc.

All Rights Reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, scanning or otherwise, except as described below, without the permission in writing of the Publisher.

Copying of articles is not permitted except for personal and internal use, to the extent permitted by national copyright law, or under the terms of a license issued by the national Reproduction Rights Organization.

Requests for permission for other kinds of copying, such as copying for general distribution, for advertising or promotional purposes, for creating new collective works or for resale, and other enquiries should be addressed to the Publisher.

Statements and opinions expressed in the articles and communications are those of the individual contributors and not the statements and opinion of Scientific Research Publishing, Inc. We assume no responsibility or liability for any damage or injury to persons or property arising out of the use of any materials, instructions, methods or ideas contained herein. We expressly disclaim any implied warranties of merchantability or fitness for a particular purpose. If expert assistance is required, the services of a competent professional person should be sought.

### **PRODUCTION INFORMATION**

For manuscripts that have been accepted for publication, please contact:

E-mail: [psych@scirp.org](mailto:psych@scirp.org)

# Positive Development in Children and the Precursors of Healthy Life-Styles: The Role of Eating Regularity and Level of Leisure Activity

Silvia Ciairano<sup>1</sup>, Giulia Bardaglio<sup>2</sup>, Emanuela Rabaglietti<sup>1</sup>, Maria Fernanda Vacirca<sup>1</sup>

<sup>1</sup>Department of Psychology, University of Turin, Turin, Italy; <sup>2</sup>SUISM – Scuola Universitaria Interfacoltà di Scienze Motorie, Centro Ricerche in Scienze Motorie e Sportive, University of Turin, Turin, Italy.

Email: [silvia.ciairano@unito.it](mailto:silvia.ciairano@unito.it)

Received May 15<sup>th</sup>, 2010; revised June 17<sup>th</sup>, 2010; accepted June 21<sup>st</sup>, 2010.

## ABSTRACT

*The two sides of children positive development, that is physical and psychological health, have been most often investigated separately. We explored the relationships between not being overweight, respecting relational rules, regularity of eating behavior (eating breakfast) and involvement in active (e.g. playing in team sport) or sedentary (e.g. playing at videogames) leisure activities shared with friends. The study was conducted among 272 Italian children (52% female; M age = 6.85 yrs) using a multi-informant design (children, parents and teachers of physical activity). Hierarchical regression analyses revealed that regularity of eating breakfast (informed by parents) was associated to lower levels of Body Mass Index (BMI) values (objectively measured) in girls. Involvement in sedentary leisure activity with friends (informed by children) was negatively associated with respecting relational rules (evaluated by teachers of physical activity) in boys. Thus, more or less active leisure activity and more or less healthy eating behaviour have some potential relevance for present and future general adjustment of boys and girls, and not only for their physical condition. Implications for educational interventions are discussed.*

**Keywords:** Children, Life-Style, Overweight, Leisure Activities

## 1. Introduction

There are at least two distinct sides to positive development [1-3]. The first side of positive development refers to physical health. In absence of other relevant pathologies, we know that an individual's body weight is a good indicator of their present and future physical health condition. We know that the problem of childhood obesity is rapidly increasing in all Western societies [4]. The manifestation of childhood obesity is a very strong risk factor for subsequent involvement in Type II Diabetes and for various other pathologies, such as cardio-vascular diseases [5].

The second side of positive development refers to psychological health. Plenty of research has shown that a good indicator of present and future psychological health is an individual's capacity to respect social rules, especially those related to relational aspects during childhood. For instance, breaking the basic relational rule of not being aggressive towards peers has been seen to result in future maladjustment.

Nowadays adults often complain about having difficulty in getting their children to respect social rules. The lack of respect of social rules may assume various configurations, from disobedience to aggressiveness and victimization of peers. We note that public opinion and the media are currently paying great attention to the latter given the great negative, physical and psychological consequences for the victims.

Although the two phenomena of obesity and transgression of rules are usually investigated separately, we would like to investigate them in the same study. We know that there have been very few previous attempts to investigate both phenomena concurrently. To our knowledge one of the few studies that have analyzed both variables in a single study is the very recent research by Giletta *et al.* [6] that found a relationship between being overweight and bullying peers in a sample of Dutch adolescents.

We know that the phenomena of obesity and of rules transgression usually increases sharply after puberty and

during early adolescence. However we are more interested in investigating these phenomena during childhood, when they are probably at their inception.

In this study we are curious to investigate whether or not there are similarities between the predictors of the two phenomena. Specifically, we think that in both cases a crucial role is fulfilled by sedentary activity. We have good theoretical reasons for anticipating the risk role of sedentary activity, although the theories we would like to employ have seldom been used before to explain behaviour in children. At first we will refer to the problem behaviour theory of Jessor *et al.*'s [7,8]. Secondly we will refer to the constructs of organized activity and of initiative of Larson [9].

### 1.1 The Precursors of Healthy Life Styles in Childhood according to the Problem Behavior Theory by Jessor

Although the theory by Jessor *et al.* is very well-known in the field of adolescent psychology, we will summarize it very briefly in order to individuate the aspects that can be adapted to earlier developmental phases, and especially to individuate some precursors of more or less healthy life-styles in childhood. Jessor and colleagues [7] theoretical framework consists of three main notions. The first notion, which is conceptually similar to the idea of development as action in context [10], concerns the fact that risk behavior, and especially that by adolescents, is not a pathological answer to internal drives or external stimulus. Rather, risk behavior depends upon the complex balance across time among the system of the person, which includes self-perception, attitudes, expectations, and values; the system of the perceived environment, which considers the relationships of the individual with the three main developmental contexts of family, peers, and school; and the system of behavior, which considers both risk behavior and conventional behavior. Also in the case of the children we can reasonably suppose that behavior depends upon the complex balance across time among physical and psychological individual characteristics, relationships with the developmental contexts of family, peers, and school and behavior themselves, for instance more active and/or more sedentary activity.

The second notion has to do with the fact that in each one of the personality, perceived environment or behavior systems some aspects are expected to fulfill the role of protective factors, while other factors are expected to work as risk factors. For instance respecting relational rules and good quality of the relationships with the peers, are expected to fulfill the role of protective factors, while other factors, as sedentary activity, are expected to work as risk factors. Generally speaking, risk factors may weaken individuals resolve not to engage in different kinds of risk behaviors. The three protective factors in

the model by Jessor *et al.* [11] are models protection, controls protection, and support protection. Models protection encompasses parents' and friends' models for health behavior. Health behaviors include diet and exercise, which can be relevant for children too. Conventional behaviors also include participation in sports. Controls protection also includes the parental controls over children behavior, such as promoting regularity of eating and the respect of relational rules during childhood. Support protection includes support from family, friends, and other important adults in the children's lives. Jessor *et al.*'s [7,8] theoretical model emphasizes that the balance among risk and protective factors contributes to the likelihood that the individual will engage in more health or risky behavior, thus to his/her adjustment. The third notion of the theoretical model by Jessor *et al.* [7] concerns the presence of a constellation or a syndrome of risk behavior, that is to say that risk behaviors are likely to co-occur: an individual who is engaged in one risk behavior (e.g., disturbed or irregular eating), also is likely to be engaged in other risk behaviors (e.g., transgression).

### 1.2 Leisure and the Development of Initiative

We also refer to some theoretical cues drawn from the literature about the potential role of organized leisure activity, and among them especially sport, in developing the individual capacity of initiative and in contributing to the positive development of people.

Larson [12] has defined the time of leisure as the fourth developmental context, together with the family, the school and the peer group, for children and adolescents. Leisure activity can be distinguished in organized or structured and in not organized and un-structured. The structured activities, which are generally led by adults, are carefully organized for realizing specific tasks and for acquiring capabilities and competences (such as in sport). The not organized and un-structured activity are all those kinds of situations that do not pursue the realization of specific tasks, the supervision of adults may lack and they happen outside any institutional context of meeting [13]. However both kinds of activity can be more active (for instance playing at team sport) or more sedentary (for instance playing at videogames). All children and adolescents are more involved at different extent in these four kinds of activities. Participation at organized and active activity has been generally found associated with a more positive development of the individuals. In particular, various studies underlined that the adolescents who participate at organized activity are less involved in risk behavior and have higher levels of self-efficacy [14,15].

Among all these activities, we are particularly interested in the kind of activity that can promote in children and adolescents the personal capacity of initiative. Ac-

According to Larson [9] the capacity of initiative is essential for developing as full members of our complex society and it will become even more important in the near future. However, despite its importance, children and adolescents have very few chances of learning and exercising this capability. In fact the normal experience of children and adolescents at school and also during the leisure time usually does not include all the necessary conditions for learning it. In our opinion, this is particularly true when they are involved in sedentary leisure activity. The context that is more adequate for developing the capability of initiative is that of volunteer but structured activity, such as that of sport, in which children and adolescents can experiment the rare combination between intrinsic motivation and concentration.

In agreement with Larson and also with other scholars [16] we believe that leisure activity, and particularly sport activity, that are organized accordingly with the above mentioned principles could represent a context particularly favorable at the positive development of children and youths. However, we also think that the combination of positive psychological conditions, intrinsic motivation and concentration could be individuated, at least partially, in more spontaneous kind of leisure activity. For instance when children meet in the courts of their houses during their free time and they organize spontaneously and by themselves for playing team sport with their peers. On the contrary we think that especially during childhood participation at un-structured and sedentary kinds of leisure activity could have negative consequences not only for the future development of the capability of initiative but also for the present and future physical health, that is in term of overweight, and for the psychosocial adjustment, especially in term of diminished possibility of developing social competence including that of respecting relational rules. A sedentary and passive type of leisure activity is unlikely to represent the adequate context for promoting social competence [17].

### 1.3 The Present Study

On the basis of the above mentioned theories, we expected that regularity of eating, and spontaneous leisure activity, active or sedentary, would emerge as possible precursors of more or less healthy life-styles during childhood. More specifically, we expected to find that regularity of eating (in terms of breakfast) and active spontaneous leisure activity would work as protective factors and thus would be associated to a more positive development of children in terms of both being not overweight and being able to respect relational rules in a social context, which we considered as two possible indicators of adjustment. Conversely, we expected to find that sedentary spontaneous leisure activity would work as a risk factor and that it would be associated with a less

positive child development, in terms of being overweight and not respecting relational rules, which we considered lack of children adjustment.

However, considering that we were unaware of previous research about similar relationships between potential precursors of healthy life-style and positive development or adjustment in childhood, our study was mainly exploratory, especially with respect to the possibility of observing gender differences. In summary we asked two key questions in this study:

1) Were there mean level differences between boys and girls on measures of physical and psychosocial positive development, and precursors of protective factors and risk factors? As anticipated this is mainly an exploratory study, however we would expect to find few differences. More specifically, and on the bases of studies on adolescents, we anticipated that girls would be more likely to respect relational rules [18] and that boys would be more likely to be involved in both sedentary and active kinds of leisure activity [19,20].

2) Did the same precursors of risk and protective factors account for variation in indicators of positive development in children in both the subsamples of boys and girls? We expected to find similar relationships with respect to both indicators of childhood adjustment in boys and girls. However, considering that the emergence of eating problems at later stages of development are generally more common in girls and conversely that transgression is more diffuse among boys, we expected to find some gender differences with respect to the patterns of relationships between indicators of adjustment and precursors of protective and risk factors.

## 2. Method

### 2.1 Participants

Participants were 272 children aged 6 to 8 ( $M = 6.85$ ,  $SD = 0.71$ ; 53% females) attending six primary schools in Cuneo, Italy. The majority of the children's parents (43% of fathers and 57% of mothers) had a high school diploma. 24% of fathers and 17% of mothers had a university degree. Most parents (99% of fathers, 78% of mothers) were employed. Regarding family structure, 92% of the parents lived together, and 8% were separated or divorced. These figures of socio-demographic information are similar to those found in the general population from the same Italian province, which is one among those at lower level of un-employment in Italy [21].

### 2.2 Procedure

As previously stated, the study was conducted in six primary schools in Cuneo, Italy. A random sample of public primary schools was invited to participate in the study and all schools contacted agreed to do so. Classes

within the schools were then randomly selected and all classes contacted accepted to take part in the study. Finally, all the parents contacted provided consent for children to participate, and children themselves assented to participate in accordance with Italian law and the ethical code of the Professional Psychologists Association in Italy. In addition, the children took the questionnaire home to their parents. 96% of the parents completed the questionnaire about socio-demographic information and children's behavior and returned it back the following week; the questionnaire was completed 57% by mothers, 13% by fathers and 26% by both parents. We did not find any relevant differences between the children of the parents who filled in the questionnaire and those who did not with respect to the other information under study.

Finally, the teachers of physical activity, who were 6 and who were all graduated in physical activity and specially trained for coaching children, observed and registered the children's behavior about respecting relational rules as regard to teachers, and classmates. This was accomplished by way of a check-list and they measured the children's Body Mass Index by way of an electronic balance during the initial session of an experimental study which will ultimately evaluate the effectiveness of the introduction of a special program of physical activity which we will consider in a future paper.

Both the children's and parents' questionnaires took approximately 30 minutes to complete. The observation of children's behavior took approximately 60 minutes to complete. Both children and parents were assured of confidentiality and anonymity. Teachers were not present in the classroom during the questionnaire administration for the children. No incentives were offered for participation; however 100% of the children completed the questionnaires.

### 2.3 Measures

*Leisure activity.* Sedentary and active leisure activity were assessed using two simplified items (selected because of children's young age) that asked children to answer whether or not they usually spend time with their friends, 1) doing active things such as playing in the court or at team sport; 2) doing sedentary things such as playing at videogames or watching TV.

*Regularity of breakfast.* The regularity of children's breakfast was assessed using one item that asked parents whether their children usually eat breakfast and ranging from 1 - Never to 4 - Always.

*Respect of relational rules by children.* This item was assessed on the basis of the evaluation of the teachers of physical activity using a simple check-list. The check-list contains the names of the children on the rows and three columns with the space for the information about respect of relational rules. During one hour of physical activity

and working in couples, scored each child was with 3 if he/she always respected some relational rules, with 2 if he/she respected them only partially and with 1 if he/she never respected them. The relational rules considered in the check-list were about: a) respecting the turn of the others; b) giving the other children enough space to move for doing their exercises. The score attributed by each teacher to each child were summed up.

*Body Mass Index.* This item was assessed by the teachers of physical activity by way of an electronic balance, which measured height and weight and calculated the Body Mass Index automatically.

## 3. Results

### 3.1 Descriptive Analyses

**Table 1** presents descriptive information of the sample and correlations among the variables by gender. To assess for gender differences on the study variables, we used t-tests for independent samples. There were no gender differences in mean levels of Body Mass Index, regularity of breakfast, and active leisure activity. However, girls ( $M = 5.75$ ,  $SD = 0.61$ ) reported more respect of relational rules than boys ( $M = 4.86$ ,  $SD = 1.04$ ),  $t(262) = 8.56$ ,  $p < 0.001$ . Boys, relative to girls, reported higher levels of sedentary leisure activity ( $M = 0.76$ ,  $SD = 0.43$  for boys;  $M = 0.66$ ,  $SD = 0.48$ , for girls;  $t(270) = 1.97$ ,  $p < 0.05$ ).

Furthermore girls and boys showed a different pattern of inter-correlations among indicators of adjustment and precursors of healthy life-style. In girls Body Mass Index was negatively associated with regularity of breakfast and positively associated with sedentary leisure activity. In boys Body Mass Index and respect of relational rules were negatively associated between each other, and respect of relational rules was negatively associated with sedentary leisure activity. Also on the basis of these different patterns of relationships, we decided to perform the following analyses separately for boys and girls.

### 3.2 Relationships among Body Mass Index, Respect of Relational Rules, Eating Behavior and Leisure Activity

To test the relationships among Body Mass Index and respect of relational rules, and among regularity of breakfast, and active and sedentary leisure activity, we used Hierarchical Linear Regression Models.

In the regression models (one for each outcome and separately for boys and girls), we entered regularity of breakfast in Step 1, active leisure activity in Step 2, and finally sedentary leisure activity in Step 3.

### 3.3 Children' Body Mass Index and Precursors of Life-Style

Only the model with girls achieved a significant propor-

tion of explained variance:  $R^2 = 0.11$ ,  $F(3, 140) = 5.67$ ,  $p < 0.0001$  with the coefficient of regularity of breakfast significant (see **Table 2**). This means that in the female sample, children who were more regular in doing their breakfast also had lower Body Mass Index that is they were less likely to be overweight.

In the male sample, we found a positive relationship between Body Mass Index and sedentary leisure activity. However, this relationship did not reach significance.

### 3.4 Children’s Respect of Relational Rules and Precursors of Life-Style

Only the model with boys achieved a significant proportion of explained variance:  $R^2 = 0.08$ ,  $F(3, 116) = 3.35$ ,  $p < 0.02$  with the coefficient of involvement in sedentary leisure activity proving significant (see **Table 3**). This means that in the male sample, children who were more involved in sedentary leisure activity also had lower

**Table 1. Intercorrelations among and descriptive information of body mass index (BMI), respect of rules, regularity of breakfast, active and sedentary leisure activity (males are below the diagonal)**

	1	2	3	4	5
1. BMI	—	0.03	-0.21**	0.01	0.14*
2. Respect of rules	-0.22**	—	-0.07	0.13	-0.03
3. Regularity breakfast	-0.04	0.01	—	-0.05	-0.07
4. Active Leisure Activity	0.06	-0.14	0.04	—	0.01
5. Sedentary Leisure Activity	0.06	-0.26**	-0.04	0.05	—
<i>M</i> (males)	16.65	4.86	3.64	0.77	0.76
<i>SD</i> (males)	2.04	1.04	0.82	0.42	0.43
<i>M</i> (females)	16.64	5.75	3.73	0.74	0.66
<i>SD</i> (females)	2.65	0.61	0.61	0.44	0.48

Notes: \* $p < 0.05$ , \*\* $p < 0.01$

**Table 2. Hierarchical regression results predicting body mass index (BMI)**

Predictors	BMI			
	Females		Males	
	<i>B</i>	$\Delta R^2$	$\beta$	$\Delta R^2$
Step 1				
Regularity breakfast	-0.31**	0.10**	-0.01	0.00
Step 2				
Active Leisure Activity	-0.05	0.00	0.02	0.00
Step 3				
Sedentary Leisure Activity	0.09	0.01	0.11	0.01

Note: \* $p < 0.05$ , \*\* $p < 0.01$

**Table 3. Hierarchical regression results predicting respect of rules**

Predictors	BMI			
	Females		Males	
	<i>B</i>	$\Delta R^2$	$\beta$	$\Delta R^2$
Step 1				
Regularity breakfast	-0.01	0.00	-0.09	0.01
Step 2				
Active Leisure Activity	0.11	0.01	-0.14	0.01
Step 3				
Sedentary Leisure Activity	-0.04	0.00	-0.23*	0.06*

Note: \* $p < 0.05$ , \*\* $p < 0.01$

levels of respect of relational rules that is they were less likely to respect these rules.

No other relationship reached significance neither in the female sample, nor in the male sample.

## 4. Discussion

The present study investigated whether regularity of eating (in terms of breakfast) and spontaneous active leisure activity functioned as protective factors; that is, if they were associated to a more positive development of children in terms of both not being overweight and of being able to respect relational rules in a social context. Besides, we investigated whether sedentary spontaneous leisure activity worked as risk factor; that is if it was associated with less positive child development. Finally we explored the presence of gender differences in both the mean levels and patterns of relationships among indicators of children’s adjustment and precursors of more or less healthy life-styles.

Although this was mainly an exploratory study, we expected that girls were more likely to respect relational rules and that boys were more involved in both kinds of leisure activity. Our findings confirmed the majority of these expectations: girls respected relational rules more than boys and boys were more involved in sedentary leisure activity with their friends. Nonetheless, we note that these findings must be considered with caution for the reasons we will list in the limitations section. However, we also think that these descriptive results deserve some reflection especially considering that we are unaware of previous studies on similar subjects. Firstly, we think that is interesting to observe that some gender differences that are generally found in adolescence, such as a greater tendency of boys to transgress, may seem to have quite early origins in childhood. This phenomenon probably starts within the socialization processes, which may still be likely to promote different kinds of behavior in male and female children [22]. Nevertheless, it is necessary to admit that this finding could also be related to the fact that the kinds of relational rules transgressions that the teachers of physical activity can register in their check-

list are by definition overt behaviors. Previous research has shown that boys are generally more likely than girls to be involved in this kind of transgression behavior and that conversely girls are usually more likely than boys to be involved in covert (or relational) types of transgression of relational rules [22,23], which are difficult to register with a check-list addressed at highlighting behavioral facets of relationships.

Furthermore, we found that females and males were much more similar than expected with respect to the kind of spontaneous leisure activity they were involved in: in fact boys were more involved than girls in sedentary activities, such as playing at videogames and watching TV. This finding resembles what has been already shown for the use of the new media: boys usually will use it more often than girls [20]. We think that is again possible to interpret this finding as a result of socialization process, which could be more likely to promote the use and the experimentation of new technologies among males.

We also hypothesized to find similar relationships among the precursors of risk and protective factors regarding regularity of eating and active and sedentary leisure activities, and with the two indicators of childhood positive development (not being overweight and being able to respect relational rules) among both genders. Indeed, we found some similarities but also some differences.

Firstly the inter-correlations showed that the two indicators of adjustment were almost independent in girls; that is to say that a girl who was overweight was not more likely to also transgress relational rules. On the contrary being overweight and transgressing relational rules were strongly related in boys. Therefore our findings seems to confirm a pattern in childhood similar to what other authors have previously highlighted in adolescence between bullying and being overweight [6]. In parallel to these authors, we also think that there are alternative explanations for this phenomenon. On one hand, perceived asymmetry of power could lead more heavy male children to use their apparent strength instead of social competence in order to try to emerge from their peers [24]. On the other hand, perceived isolation from the peer group due to being overweight could stimulate the need to find alternative ways for improving one's own social acceptance in the peer group: in this case, transgressing rules could represents an attempt of becoming more interesting at the eyes of peers [25]. However, further longitudinal research is certainly needed for individuating the direction of this relationship.

Secondly, we were able to predict being overweight only in girls and being more likely to transgress relational rules only in boys. As anticipated, this may be interpreted as an indication of the differential importance of these two indicators of adjustment in boys and girls at

later stages of development, such as during adolescence [18]. However, again longitudinal studies are needed for disentangling the direction of these relationships. At the present stage of this research we cannot state whether being overweight in girls is a result of irregularity of eating habits or on the contrary whether eating behavior becomes irregular as a reaction of having become previously overweight and thus an unsuccessful attempt of reducing weight. At the same extent we do not know whether transgressing relational rules in boys is the result of lack of experimentation of social competence due to abundance of sedentary behavior or on the contrary whether sedentary behavior becomes more likely a way to answer perceived discomfort in peer relationships and thus as an attempt at constructing one's own social reputation. In this latter case we would need both a longitudinal design and also different measures in order to investigate the direction of the relationships and also to evaluate the occurrence of social isolation and aggressiveness towards peers.

Thirdly, while regularity of eating was found to be related only with Body Mass Index, involvement in sedentary activity was found to be related especially with transgression of relational rules. Thus, we found almost two separate syndromes instead of the expected one, the former more concerned with the so-called internalizing problems and that seems more relevant for girls, and the latter more concerned with externalizing problems and that seems more important for boys. Although, there is some indication that internalizing problems may develop in an almost independent pattern with respect to that of externalizing problems [26], we would like to know more about their developmental paths.

## 5. Strengths and Limitations

Two key limitations of the present study are the cross-sectional design and the relative weakness of some of the measures employed, although the young age of the participants forced us to use longer series of items. These two limitations precluded us from investigating the direction of the relationships we found and also to use more complex strategies of analyses which could have shed more light on the phenomenon under study. The next step in this line of research is to investigate these associations over time and also to introduce some measures of social isolation and aggressiveness. For instance, it might be useful to know whether being overweight or being more likely to transgress relational rules in childhood might contribute to the chance of bullying other people or being victimized in early adolescence for boys, and whether being overweight in childhood contributes to the further development of eating problems or other kinds of internalizing symptoms later on for girls.

The relatively small sample size and the fact that all

participants resided in one region of Italy also makes it difficult to generalize results to different populations.

In spite of its limitations, this study has also some merits.

First, it has highlighted the importance of investigating the precursors of more or less healthy life-styles in childhood although they can assume different figures in subsequent phases of development. Second, it has underlined the importance of collocating children and not only adolescent adjustment in the complex web of relationships between personal characteristics, life contexts and behaviour. Third, it has shown that parents can do something very simple to prevent their children being overweight which is to promote regularity of their eating behaviour.

Finally, it has highlighted the potential relevance for present and future adjustment of more sedentary or more active leisure activity and not only with respect to physical condition. We are really convinced that introducing special kinds of physical activity curricular programs to children, structured in the ways suggested by Larson [9] and Fraser-Thomas, Côté, Deakin [16], can be really helpful to promote more positive development in children and that it can have positive consequences for their future adjustment in terms of both physical and psychological health. To implement this kind of intervention and to evaluate its effectiveness is one of our next steps.

## 6. Acknowledgements

This study was partially funded by CRC Foundation, Cuneo, Italy. We warmly thank Fulvia Gemelli, Giovanni Musella and Monica Liubicich, S.U.I.S.M., Torino, Italy, for their support and suggestions for the realisation of this research. We also thank the students of MA at the Faculty of Psychology and at S.U.I.S.M., Torino, Italy who served respectively for administering questionnaires and for evaluating the children's behaviour and Body Mass Index. Finally, we thank the children and their parents and teachers who accepted to participate at this study with great enthusiasm.

## REFERENCES

- [1] W. Damon, "What is Positive Youth Development?" *The Annals of the American Academy of Political and Social Science*, Vol. 591, No. 1, 2004, pp. 13-24.
- [2] S. F. Hamilton, M. A. Hamilton and K. Pittman, "Principles for Youth Development," In: S. F. Hamilton and M. A. Hamilton, Eds., *The Youth Development Handbook. Coming of Age in American Communities*, Sage Publications, Inc., Thousand Oaks, 2004, pp. 3-22.
- [3] C. Peterson, "Positive Social Science," *The Annals of the American Academy of Political and Social Science*, Vol. 591, No. 1, 2004, pp. 186-201.
- [4] World Health Organization, "Global Strategy on Diet, Physical Activity and Health," WHO, Genève, 2004.
- [5] G. S. Berenson, S. R. Scrivinasan, W. Bao, W. P. Newman, R. E. Tracy and W. A. Wattigney, "Association between Multiple Cardiovascular Risk Factors and Atherosclerosis in Children and Young Adults. The Bogalusa Heart Study," *The New England Journal of Medicine*, Vol. 338, No. 23, 1998, pp. 1650-1656.
- [6] M. Giletta, R. H. J. Scholte, R. C. M. E. Engels and J. Larsen, "Bullying Involvement among High Weight Status Adolescents," Submitted at *Journal of Adolescence*.
- [7] R. Jessor, J. E. Donovan and F. M. Costa, "Beyond Adolescence—Problem Behavior and Young Adult Development," Cambridge University Press, Cambridge, 1991.
- [8] R. Jessor, M. S. Turbin, F. M. Costa, Q. Dong, H. Zhang and C. Wang, "Adolescent Problem Behavior in China and the United States: A Cross-National Study of Psychosocial Protective Factors," *Journal of Research on Adolescence*, Vol. 13, No. 3, 2003, pp. 329-360.
- [9] R. W. Larson, "Toward a Psychology of Positive Youth Development," *American Psychologist*, Vol. 55, No. 1, 2000, pp. 170-183.
- [10] R. K. Silbereisen, K. Eyferth and G. Rudinger, "Development as Action in Context," Springer-Verlag, Berlin, 1986.
- [11] D. Hayes and C. E. Ross, "Body and Mind: The Effect of Exercise, Overweight, and Physical Health on Psychological Well-Being," *Journal of Health and Social Behavior*, Vol. 27, No. 4, 1986, pp. 387-400.
- [12] R. W. Larson, "Youth Organizations, Hobbies, and Sports as Developmental Contexts," In: R. K. Silbereisen and E. Todt, Eds., *Adolescence in Context: The Interplay of Family, School, Peers, and Work in Adjustment*, Springer-Verlag, New York, 1994, pp. 46-65.
- [13] J. L. Mahoney and H. Stattin, "Leisure Activities and Adolescent Antisocial Behavior: The Role of Structure and Social Context," *Journal of Adolescence*, Vol. 23, No. 2, 2000, pp. 113-127.
- [14] A. Bandura, "Self-Efficacy: The Exercise of Control," Freeman Publishers, New York, 1997.
- [15] A. J. Huebner and J. A. Mancini, "Shaping Structured Out-of-School Time Use among Youth: The Effect of Self, Family and Friend System," *Journal of Youth and Adolescence*, Vol. 32, No. 6, 2003, pp. 453-463.
- [16] J. L. Fraser-Thomas, J. Côté and J. Deakin, "Youth Sport Programs: An Avenue to Foster Positive Youth Development," *Physical Education and Sport Pedagogy*, Vol. 10, No. 1, 2005, pp. 19-40.
- [17] B. J. Bredemeier and D. L. Shields, "Moral Growth through Physical Activity: A Structural Developmental Approach," In: D. R. Gould and M. R. Weiss, Eds., *Advances in Paediatric Sport Sciences*, Human Kinetics Publishers, Champaign, Vol. 2, 1987, pp. 143-165.
- [18] S. Bonino, E. Cattelino and S. Ciairano, "Adolescents and Risk Behaviors, Functions and Protective Factors," Springer

- Verlag, Milan, 2005.
- [19] R. J. Brustad, "Attraction to Physical Activity in Urban Schoolchildren: Parental Socialization and Gender Influences," *Research Quarterly for Exercise and Sport*, Vol. 67, No. 3, 1996, pp. 316-323.
- [20] J. Colwell, C. Grady and S. Rhaiti, "Computer Games, Self-Esteem, and Gratification of Needs in Adolescents," *Journal of Community and Applied Social Psychology*, Vol. 5, No. 3, 1995, pp. 195-206.
- [21] National Institute of Statistics (ISTAT), "Annuario Statistico Italiano 2007 (Italian Statistical Yearbook 2007)," ISTAT, Rome, 2007.
- [22] E. E. Maccoby and C. N. Jacklin, "Sex Differences in Aggression: A Rejoinder and Reprise," *Child Development*, Vol. 51, No. 4, 1980, pp. 964-980.
- [23] K. Björkqvist, "Sex Differences in Physical, Verbal, and Indirect Aggression: A Review of Recent Research," *Sex Role*, Vol. 30, No. 3-4, 1994, pp. 1573-2762.
- [24] A. D. Pellegrini, "Affiliative and Aggressive Dimensions of Dominance and Possible Functions during Early Adolescence," *Aggression and Violent Behavior*, Vol. 7, No. 1, 2002, pp. 21-31.
- [25] S. Harter, C. Stocker and N. Robinson, "The Perceived Directionality of the Link between Approval and Self-Worth: the Liabilities of a Looking Glass. Self-Orientation among Adolescents," *Journal of Research on Adolescence*, Vol. 6, No. 3, 1996, pp. 285-308.
- [26] K. K. Davison, M. B. Earnest and L. L. Birch, "Participation in Aesthetic Sports and Girls' Weight Concerns at Ages 5 and 7," *International Journal of Eating Disorders*, Vol. 31, No. 3, 2002, pp. 312-317.

# “Fun, Fun, Fun”: Types of Fun, Attitudes to Fun, and their Relation to Personality and Biographical Factors

I. C. McManus, Adrian Furnham

Research Department of Clinical, Educational and Health Psychology, Division of Psychology and Language Sciences, University College London, London, UK.  
Email: [i.mcmanus@ucl.ac.uk](mailto:i.mcmanus@ucl.ac.uk)

Received May 16<sup>th</sup>, 2010; revised June 29<sup>th</sup>, 2010; accepted June 31<sup>st</sup>, 2010.

## ABSTRACT

*This study explores the psychologically neglected concept of fun, a concept that contributes strongly to many people's perceptions of quality in life, and looks both at the different types of behaviour that people regard as fun and the attitudes that people have towards fun. Through focus groups and interviews, a 40-item attitude questionnaire was developed and completed by 1100 people. Factor analysis identified five attitudinal factors, which were labelled as “Fun involving risk-taking”; “Fun dependent on fun people”; “Fun causing happiness”; “Money needed to have fun”; and “Spontaneity as fun”. These different factors showed different patterns of correlation with demographic and personality measures. The different types of situation that people described as fun were assessed by asking participants to use an adjective check-list to describe a situation they had found to be fun. Factor analysis identified five types of fun (“Sociability”, “Contentment”, “Achievement”, “Sensual” and “Ecstatic”), the different types correlating systematically with participants' demography, personality and attitudes to fun. Although often used as if it were a single concept, “fun” is actually a complex phenomenon that has different meanings for different types of people.*

**Keywords:** Fun, Big Five, Personality, Demography, Leisure Activities

## 1. Introduction

If searching for an epithet for the *Zeitgeist* of the opening years of the twenty-first century, then the word “fun” might well be suitable. Typing “fun” into the search engine Google in finds no less than 662,000,000 websites (and in comparison, “sex” achieved only 655,000,000 hits; all search engine figures at August 2009). Likewise, Amazon.com finds 607,923 results for books containing the word (and Amazon.co.uk found 30,659 titles), with the best-seller for adults being 301 *ways to have fun at work*, which perhaps typifies the genre. The all-pervasive nature of fun in advanced modern societies such as the United States has been eloquently summarised by Bryant and Forsyth [1]:

“The United States is a society that has become almost pathologically obsessed with fun. Fun is a source of enjoyment, pleasure, amusement, and even excitement. ... Today the pursuit of happiness (and fun) is, in effect, the national quest, and this goal permeates our lives. ... The pursuit of fun has a place of dominant

centrality in our daily lives, but fun seeking is not a compartmentalized area of our cultural fabric. Rather, it is constituent to almost every aspect of our daily lives. Fun seeking is very much integrated into our entire culture and in our daily cycle of life - home, work, rest, maintenance, and even sleep. Our hedonistic quest has become a deified entity of its own — the Fun God, as it were.”

Bryant and Forsyth's phrase “the Fun God” is reminiscent of *Psychology and “the great god fun”*, by AE (“Tajar”) Hamilton [2], a book whose title makes one aware of the near total absence of serious interest of psychologists in the nature of fun (although the book itself has little serious analysis of the concept). A search of PsycINFO found only 246 pieces with “fun” in the title, of which the vast majority were mostly concerned with using fun as an intervening or outcome variable in education, health education or other activities (e.g. [3-8] or with topics such as helping academics to write for a general audience [9] or carry out structural equation modelling [10].

Conceptualising fun is not straightforward, in part because of the number of synonyms for fun such as amusement, enjoyment and entertainment, and in addition every generation seems to produce its own synonyms for fun, such as "far out" or "cool". Fun is therefore a complex word with multiple meanings referring to affective and motivational properties. People seek out fun activities but respond to situations with a sense of fun, so that fun can be an activity, a state, or a trait. Fun can be used both as a motivational concept: "to want to have fun" or a trait concept, "They are a fun-loving sort of person", but it is most often described as the property of a behavioural repertoire or social situation: "The dinner party was fun". The opposite of fun is usually thought of as tedious, boring, dull, or other synonyms. The fact that psychologists almost never use the word makes it difficult to offer a definition that clearly distinguishes it from other positive emotional elicitors, triggers or states. A principle aim of this study is therefore to try to understand how lay people understand the term.

The psychological literature on fun is very limited, and occasionally psychologists have noted that certain concepts never seem to appear within psychological studies. Argyle [11] kept a list of such words which indeed included "fun". Furnham [12] pointed out that fortitude was such a word, and until recently this was also true of stoicism [13]. As far as we know, no psychology text book has fun in its index. Perhaps other synonyms are used in its place? There seems two literatures which contain concepts near to that of the fun concept. The first is from the work on motivation. The concept of intrinsic motivation captures some of the theme of fun [14], with the idea that some people are motivated to do something (usually work) because of the sheer enjoyment or fun of the activity itself. The activity or task is its own reward requiring no other reward such as approval, money or social contact. Words used in this regard for intrinsic motivation include hedonistically satisfying, optimally arousing and deliciously complex [15].

The second area of research where the concept of fun might appear is the research on positive psychology and happiness [16,17]. Early studies on the components of happiness mentioned various concepts like joy, hope, and flow, which were often considered to be the emotional side of happiness. For some joy was the opposite of depression [18]. Equally those working on the emotions have suggested a two orthogonal factor model, for which the first dimension is happy-sad and the other excited-relaxed [19]. Various writers have specified different types of happiness, some more akin to fun than others. Seligman [20] distinguished between a pleasant, engaged, good and meaningful life, while Morris [21] distinguished between seventeen types of

happiness, including cerebral, tranquil and chemical happiness. Fun appears to be close to Seligman's *pleasant-happiness* and Morris' sensual, fantasy or comic happiness [22].

Only in a very occasional set of studies is there a direct confrontation with the nature of fun and its definition. As can be seen the concept is rarely well defined, and often *a priori* theoretical assumptions are made about its nature. In an extensive qualitative study entitled "How rural low-income families have fun" [23], the authors consistently use the word "fun" in quotes, thereby emphasising its theoretical difficulty, while acknowledging that in their study it is hard to differentiate from leisure, such that "the mothers' definitions and connotations of the word "fun" might not be congruent with research-based definitions", after which no further definition is either provided or emerges from the grounded theory analysis. Likewise the opening line of the analysis by Garn and Cothran [24], entitled "The fun factor in physical education", also puts fun in quote marks, saying how "both students and teachers rate "fun" at or near the top of their lists of goals for physical education". After reviewing several studies in physical education they eventually conclude only that, "the fun construct is a complex one consisting of a variety of factors ... without a solid conceptual framework". Similarly, Jackson [25], in an article entitled, "Joy, fun and flow state in sport", comparing various positive experiences associated with sport, comments, "Fun at first seems a more straightforward concept than joy, especially in sport, where the term is used so often. Everyone knows what fun is, right? But getting beyond 'sport is fun' is not easy." The remainder of that paper then concentrates almost entirely on flow states, concluding eventually only that, "flow is key to understanding the joy, happiness, fun and enjoyment in sport... Not [though] that flow is the only path to these experiences". Finally, Middleton, who has published on the role of the importance of "academic fun" for gifted children [26], somewhat begs all the theoretical questions about the nature of fun when in a later paper he states at the very beginning that, "throughout this paper, I use the terms 'intrinsic motivation' and 'fun' interchangeably. The colloquial term 'fun' is better understood by students and teachers (and researchers), and carries connotations of positive affect that 'intrinsic motivation' may not" [27]. This forces fun into the conceptual mould of intrinsic motivation, while accepting that that may not be how participants themselves understand it. Together these four papers show the lack of conceptual clarity in the literature concerning the nature of fun, and yet show both the central relevance of the concept to lay thought and motivation, and the need to address the concept directly, rather than by assuming that it necessarily relates to some other

single theoretical concept already described within psychology such as leisure, flow or intrinsic motivation.

The only (unpublished) study we have been able to find that asks directly about what experiences are actually included under the heading of fun, is that of Slaughter [28] who asks directly about a range of activities and makes conclusions both about fun people and fun experiences, suggesting that a high fun person is, “is a hedonist—an active, aggressive, impulsive adventurer who does not require intellect or sensitivity to himself or those around him”, whereas a fun experience, “is likely to be an Affective or Sensori-Motor experience and less likely a Cognitive experience. It is about equally likely to be Cooperative or Solitary in nature and less likely to be a Competitive activity”. The present study takes the nature of fun and its potential variability between individuals, as the central question that needs to be asked, acknowledging the potentially multi-faceted nature of the term.

In this paper we wish to describe an exploratory study of what a large group of adults think of fun and its nature. The study had multiple objectives, and in the paper we will describe them in the following order. Firstly, we provide a taxonomy of the types of activities or experiences that people include under the heading of fun, and secondly we examine how the various types of fun experience chosen are related to demographic factors such as age, sex and social class; to personality; and to education and particularly to science education (and in previous studies we have found that studying science is associated with different cultural and aesthetic activities and hence it seems at least possible that they are will also be related to fun [29]). Thirdly, we assessed how attitudes to fun differ, where attitudes refers to people’s beliefs about how best to achieve fun and the extent they seek it our under different conditions, and we then looked at how such attitudes relate to the various background factors. Finally, we asked how the types of fun and also attitudes towards fun related to participation in a range of cultural and aesthetic activities that we have studied extensively before, and which are often described as being done for fun [30]. This is inevitably an exploratory study, but it is in the research tradition on lay theories of happiness [31-33], but this time looking at fun.

## 2. Method

The data in this study were collected as part of a large undergraduate laboratory class at University College London (UCL). The class in its present format has now been running for several years, and studies from previous years, on other topics, have been published elsewhere [25,30,34].

### 2.1 The Lab Class

The class runs for three successive weeks, and introduces students to different research methods for studying attitudes. The topic is purposely only vaguely defined, and often is one with little formal research in the psychological literature, encouraging students to explore the richness of the question, and to follow their own directions. For the January 2008 class the topic was simply, “Fun”.

The class was split into ten groups of about ten students who worked together for three full days over successive weeks, in conjunction with a demonstrator. In week 1 students ran small focus groups to explore the issues and attitudes, and the groups then chose two interviewees who were likely to be informative about the issues. The semi-structured interviews were transcribed it in a standard fashion, and students had access to all interviews carried out by all groups, and they used those interviews as a resource for writing questions for the quantitative questionnaire study.

The main part of the questionnaire consisted of a folded sheet of A3 paper (*i.e.* 4 A4 sheets), the middle two pages of which contained 40 attitude questions written by the students to a pre-defined rubric, each group providing four questions. The questionnaire was assembled at the end of Week 2, and each student collected 12 copies which they distributed to participants (see below). The data were entered into an SPSS data file which was analysed during week 3. For the present analysis, only the quantitative data will be considered although it is important to remember that the breadth and quality of the attitude questions derives in large part from the in-depth qualitative research carried out beforehand.

### 2.2 The Questionnaire

This consisted of four printed pages. Page 1 contained eleven standard questions on demographics, education and social background. Pages 2 and 3 contained the forty attitude questions written by the students, and Page 4 contained a specially written question on a fun situation (see below), a set of twenty questions on participation in a range of cultural and aesthetic activities, which were extended from a set used in our previous study [30], and a brief measure of the Big Five personality dimensions which we have used in previous studies [30,34,35], and has three items on each of the five factors (see <http://www.ucl.ac.uk/medical-education/resources/questionnaires> for details). Alpha reliabilities for neuroticism, extraversion, openness to experience, agreeableness and conscientiousness were 0.561, 0.590, 0.611, 0.505 and 0.541, which are comparable to previous values, and, as we have argued elsewhere, are more than adequate for surveys with large samples such

as the present one [30,36], where the interest is primarily correlational. Means (SDs) were 8.40 (2.37), 10.73 (2.16), 10.44 (2.56), 12.08 (1.98) and 10.45 (2.35) respectively.

### 2.3 Question on a Fun Situation

This question was written specially for the study, and began by asking participants to, "Think of a typical situation *when you were having fun*. Please describe it in three or four words". The question then continued, "Now, ring any of the [forty-two] words below that describe your feelings in that situation", after which followed the alphabeticised list of adjectives shown in **Table 1**. Although original, the questionnaire was inspired by previous adjective checklists in other situations [37-39], and in particular the study of Dubé and Le Bel [40] on the nature of pleasure.

### 2.4 Participants

Each undergraduate in the class was asked to find 12 participants who would complete the questionnaire, and it was said that these should broadly be "students", with the term not being rigorously defined, the only requirement being that respondents were aged 18 or over, and in some sense were or had been students. A stratified sampling scheme was used, each undergraduate obtaining completed questionnaires from 3 male participants who broadly could be regarded as scientists, 3 female participants who were scientists, 3 male participants who were not scientists, and 3 female participants who were not scientists. Apart from the stratification, students in the class were asked to be as wide-ranging as possible in finding the participants, with it being emphasised that participants need not just be from UCL, but could include friends, relations and colleagues, and they specifically should not be psychology undergraduates at UCL. The intention was therefore to obtain a large convenience sample for the purposes of data exploration. There was no expectation that the sample should be representative of the population as a whole, and the present paper should be interpreted with that limitation in mind. The data however are probably adequate for exploring the inter-relationships and correlations between measures, but care should be taken in the interpretation of absolute percentages and means. Although it might be a concern with our sampling method that some data may have been fabricated, or that some subjects may inadvertently have been included twice, a previous analysis [30] has shown that not to be the case, and there was no reason to believe either could be the case in the present study.

### 2.5 Statistical Analysis

Statistical analyses used SPSS v13.0.

**Table 1. The first column shows the descriptors used for the fun situation, and the last column shows the overall percentage of respondents including the descriptor. The middle five columns show the loadings on the five varimax-rotated factors, sorted by size and with loadings less than 0.2 set as blank. Loadings greater than .4 are in bold. Descriptors in the questionnaire itself were in alphabetical order**

Descriptor	Factor:					%
	1	2	3	4	5	
	Socia- bility	Con- tentment	Achieve- ment	Sensual	Ecstatic	
joking	<b>0.678</b>	-	-	-	-	43.8%
laughing	<b>0.602</b>	-	-	-	-	62.2%
talking	<b>0.568</b>	0.231	-	-	-	40.3%
entertained	<b>0.514</b>	-	-	-	-	51.6%
witty	<b>0.489</b>	-	-	-	-	25.0%
spontaneous	<b>0.455</b>	-	-	-	0.218	37.8%
playful	<b>0.455</b>	-	-	-	0.258	43.2%
happy	0.349	0.272	-	-	-	71.8%
self- confident	0.338	-	0.227	-	-	34.0%
public	0.249	-	0.202	-	-	12.1%
peaceful	-	<b>0.569</b>	-	-	-	17.4%
warm	0.235	<b>0.499</b>	-	-	-	26.5%
relaxed	0.283	<b>0.476</b>	-	-	-	46.6%
loving	0.256	<b>0.463</b>	-	0.256	-	26.3%
caring	0.220	<b>0.459</b>	-	-	-	16.0%
contented	0.200	<b>0.445</b>	-	-	-	36.4%
blissful	-	<b>0.409</b>	-	-	0.212	15.4%
fulfilled	-	0.380	0.354	-	-	28.6%
stress free	0.298	0.363	-	-	-	47.9%
private	-	0.336	-	0.269	-	8.6%
joyful	0.247	0.331	-	-	0.278	44.0%
lazy	-	0.246	-	-	-	8.2%
focused	-	-	<b>0.638</b>	-	-	18.8%
challenged	-	-	<b>0.616</b>	-	-	22.6%
accomplished	-	-	<b>0.458</b>	-	-	12.0%
absorbed	-	-	<b>0.448</b>	-	-	28.7%
engrossed	-	-	<b>0.414</b>	-	-	17.5%
inspired	-	0.296	<b>0.403</b>	-	-	21.1%
proud	-	-	0.380	-	-	13.8%
nervous	-	-	0.369	-	-	6.9%
fearful	-	-	0.293	-	-	4.9%
amazement	-	-	0.293	-	0.200	15.5%
surprised	-	-	0.228	-	-	9.5%
sensual	-	-	-	<b>0.661</b>	-	9.3%
lustful	-	-	-	<b>0.502</b>	-	8.7%
intimate	-	0.318	-	<b>0.501</b>	-	13.4%
romantic	-	0.243	-	<b>0.480</b>	-	10.7%
vulnerable	-	-	0.231	0.306	-	4.4%
ecstatic	-	-	-	-	<b>0.560</b>	20.6%
crazy	0.205	-	-	-	<b>0.487</b>	27.1%
excited	0.234	-	0.312	-	<b>0.486</b>	47.7%
energetic	0.282	-	-	-	<b>0.439</b>	47.6%

### 3. Results

Questionnaires were completed by 1100 respondents, of whom 1088 gave their sex (males  $n = 534$ , 49.1%; female  $n = 554$ , 50.9%), with an age range of 18 to 78 (mean = 25.5, median = 21, SD = 10.71, quartiles 20 - 25), with 142 (12.9%) of the respondents being aged over 40. 964 subjects indicated that they were studying for or had obtained a degree, and the subjects self-classified subjects according to the 13 categories used by UCAS, and arbitrarily, but in a similar way to previous studies [29;30], we classified Medical Science, Biological science, Physical science, Mathematics and Engineering as science subjects. On that basis, 38.9% of respondents (375/964) were studying science.

Social class was assessed on the occupations of each parent, based on the five-point Registrar-General's scale, with class overall defined as the higher of the two parents' occupations, scored I = 5, II = 4, III = 3, IV = 2 and V = 1, so that high scores correlated with higher social class. Overall, of 1031 respondents, 515 (50.0%) were from social class I, 306 (29.7%) from class II, 153 (14.8%) from class III, 35 (3.4%) from class IV, and 22 (2.1%) from class V.

#### 3.1 The Fun Situation and Types of Fun

All but 48 subjects described a situation in which they had recently been having fun, Of the 42 adjectives describing the situation, 40 subjects ticked none of them, and one ticked all 42, and these 41 subjects were removed from further analysis. Table 1 shows the overall proportion of respondents ticking each of the adjectives. Factor analysis was carried out using principal axis factoring with varimax rotation. A scree-slope analysis suggested that there were five factors (the first ten eigenvalues being 6.22, 3.33, 2.55, 1.88, 1.37, 1.27, 1.22, 1.17, 1.05 and 1.01), with reliabilities of 0.745, 0.773, 0.800, 0.701 and 0.764 respectively. The factor structure shown in Table 1 is very clear. Scores were extracted for each factor. To aid in describing the factors, participants were identified who had a loading of below zero on four of the five factors, and the descriptions then examined for those with the highest loadings on the remaining fifth factor.

- *Fun type 1* can be described as *Sociability*, with large loadings on joking, laughing, talking, and entertainment, with high scorers describing the situation as “socializing with friends”, “hanging out with friends”, “enjoy, relaxed, excited”, “Being with friends”, “out with friends”, “socialising with friends”, “when I'm with the girls”, “board game with friends”, “drunken sports night with friends”, and “out with friends”.
- *Fun type 2* can be labelled as *Contentment*, with

its loadings on peaceful, warm, relaxed, loving, caring, and contentment. High scoring situations were “gardening”, “just being at home”, “went to Southampton beach”, “being with people I like”, “swimming”, “with friend, in fave cafe, study”, “chatting with mates”, “smiley laughing content”, “swimming in the sea” and “listening to music”.

- *Fun type 3* can be labelled as *Achievement*, with high loadings on focussed, challenged, accomplished, absorbed and engrossed, and contains some sense of a flow state. High scoring situations included, “acting in a play”, “playing football with friends”, “working on my GPS tracer project”, “winning in a game”, “horse riding”, “computer games with friends”, “jamming with friends”, “when I was creating something”, “when learning something interesting”, “achieving a goal”, and “racing, mountain, skis, speed”.
- *Fun type 4* is labelled Sensual, but might also be labelled romantic or sexual with its loadings on sensual, lustful, intimate and romantic. Relatively few participants scored highly on this factor but amongst those who did the descriptions were “having sex” (reported by three participants), “food and good company”, and “spending time with my boyfriend”.
- Finally, *fun type 5* is readily described as *Ecstatic*, with loadings on ecstatic, crazy, excited and energetic. Typical situations were “amusement parks”, “Exhilarating, exciting, unpredictable, amusing”, “partying, drinking, watching films”, “going clubbing”, “clubbing with friends”, “elation euphoria enjoy”, “clubbing”, “pub/clubbing”, “visiting night clubs”, and “at a rave”.

#### 3.2 Correlates of Fun Types

**Table 2** shows correlations of scores on the five fun types in relation to demographic factors (age, sex, science education and father's social class), and to the big five personality factors. Overall women reported more fun situations involving sociability, and contentment, and less with achievement, and older respondents reported more fun involving contentment and achievement, and less sociability, sensual or ecstatic fun. Neither social class nor a science education related to the type of run reported. Personality showed several very significant associations, and considering only those with  $p < 0.001$ , extraversion was associated with sociability and ecstatic fun, agreeableness with more fun involving sociability and less that was sensual, and openness to experience with more fun involving achievement. Neither neuroticism nor conscientiousness showed correlations at the  $p < 0.001$  level with the types of fun.

**Table 2. Correlates of scores on the five fun types in relation to background variables and personality. Ns vary from 964 to 1059. Key: \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ . Correlations greater than 0.1 are in bold**

Fun type	1	2	3	4	5
	Sociability	Contentment	Achievement	Sensual	Ecstatic
Female	0.067*	0.084**	<b>-0.115***</b>	-0.033	-0.001
Age	-0.062*	0.083**	0.071*	-0.052	<b>-0.159***</b>
Science education	0.016	0.009	0.036	-0.047	0.030
Social class	0.040	-0.057	0.006	-0.035	0.052
Neuroticism	0.028	-0.065*	-0.014	0.022	0.097**
Extraversion	<b>0.190***</b>	-0.060*	-0.028	0.081**	<b>0.253***</b>
Openness	0.053	0.081**	<b>0.148***</b>	0.014	0.054
Agreeableness	<b>0.187***</b>	0.062*	0.016	<b>-0.101***</b>	0.004
Conscientiousness	0.040	0.049	0.055	-0.061*	0.000

### 3.3 Attitudes towards Fun

The forty attitude questions were factor analysed using principal axis factoring, followed by varimax rotation and factor score extraction. The scree slope suggested five main factors, with first ten eigenvalues being 4.03, 3.16, 1.95, 1.73, 1.47, 1.39, 1.37, 1.23, 1.12 and 1.09. The five factors, which had reliabilities of respectively 0.800, 0.778, 0.655, 0.700 and 0.725, were identified as follows:

- *Fun attitude 1* which was labelled *Risk-taking*. Participants with high scores tended to agree with questions asking, "Are you willing to take risks to have fun?", "Would you repeat a certain activity that carried a health risk in order to have fun?", "Can you have fun when you are scared?", "Would you consider breaking the law to have fun?" and "Is an activity more fun if there is risk involved?"
- *Fun attitude 2* was the most difficult to label. High scorers tended to agree with questions asking, "Is it important to have a similar personality as people in order to have fun with them?", "Is the presence of other people essential to have fun?", "Do extraverted people have more fun than introverted people?", and disagreed with the question, "Is it possible to have fun by yourself?". The main thrust seems to be on fun as a sociable activity, dependent on particular types of other people, and it was therefore labelled *Fun people*.
- *Fun attitude 3* was characterised by participants agreeing with questions that asked, "Is fun one of the requirements we ought to fulfil in life?", "Do

you think you need to have fun to be happy?", "Does having fun always involve happiness?", "Can fun provide you with happiness in the long-term?" and "Does unhappiness restrict your ability to have fun?". Fun and happiness seem here to be causally related, and the factor was labelled *Fun causing happiness*.

- *Fun attitude 4* was straightforward, with those scoring highly agreeing to questions that asked, "Do rich people have more fun?", "Do you have more fun if you spend more money?" and "Do you think the amount of money that you have influences how much fun you have?". This can be labelled as *Money*.
- Finally, *fun attitude 5* was characterised particularly by answering Yes to the two questions, "Are unplanned activities more fun than planned ones?" and "Is spontaneous fun more enjoyable than planned fun?". This can be labelled as *Spontaneity*.

### 3.4 Correlates of Fun Attitudes

The five fun attitudes were correlated with the demographic and personality variables used earlier, and with the fun types which had been identified (**Table 3**). For simplicity, only correlations significant with  $p < .001$  will be considered. Female participants were less likely to consider risk-taking as important in having fun, as also were older subjects, who also thought that fun people were less important. Neither a science education nor social class related to the attitudes towards fun.

Personality showed strong correlations with attitudes towards fun. Extraverts saw risk-taking, fun people and spontaneity as important, whereas while those with greater openness to experience also saw risk-taking as important, they also saw both fun people and money as unimportant. Agreeable individuals saw fun people and money as unimportant in having fun, whereas they did see fun as causing happiness. Finally, participants with higher neuroticism scores saw fun people as important to having fun.

Attitudes to fun correlated with types of fun in straightforward ways. Those describing sociable types of fun, saw risk-taking as important to fun, and fun as causing happiness.

Those describing contentment as fun saw risk-taking as unimportant, and those describing achievement in their fun seeing fun people as unimportant to having fun. Sensual types of fun were associated with money as being important, and those describing ecstatic fun types saw risk-taking as important, and fun as causing happiness.

### 3.5 Cultural and Aesthetic Correlates

If attitudes towards fun differ between people, and

**Table 3. Correlates of scores on the five fun attitudes in relation to background variables and personality. Ns vary from 964 to 1059. Key: \* p < 0.05; \*\* p < 0.01; \*\*\* p < 0.001. Correlations greater than 0.1 are in bold**

Fun attitude	1	2	3	4	5
	Risk taking	Fun people	Fun causing happiness	Money	Spontaneity
Female	<b>-0.159***</b>	0.053	0.011	-0.064*	-0.037
Age	<b>-0.254***</b>	<b>-0.131***</b>	-0.049	-0.014	0.036
Science education	0.021	-0.042	0.030	-0.033	-0.059
Social class	0.075*	0.032	0.000	-0.050	0.021
Neuroticism	-0.015	<b>0.144***</b>	0.007	0.080**	0.048
Extraversion	<b>0.255***</b>	0.099**	<b>0.247***</b>	0.005	<b>0.118***</b>
Openness	<b>0.193***</b>	<b>-0.175***</b>	-0.039	<b>-0.128***</b>	0.036
Agreeableness	-0.104**	<b>-0.150***</b>	<b>0.142***</b>	<b>-0.161***</b>	0.046
Conscientiousness	<b>-0.164***</b>	-0.074*	0.004	0.029	-0.041
Fun type 1: Sociability	<b>0.129***</b>	-0.080**	<b>0.164***</b>	-0.045	0.099**
Fun type 2: Contentment	<b>-0.125***</b>	-0.098**	-0.059	-0.062*	-0.030
Fun type 3: Achievement	<b>0.101**</b>	<b>-0.133***</b>	-0.041	0.040	-0.079**
Fun type 4: Sensual	0.092**	0.068*	0.019	<b>0.132***</b>	0.075*
Fun type 5: Ecstatic	<b>0.202***</b>	0.072*	<b>0.178***</b>	0.028	0.083**

people typically derive fun from different activities, then it would be expected that there would be correlations with involvement in differing cultural and aesthetic activities. **Table 4** shows correlation between the types of fun and attitudes towards fun, and twenty activities. There are 23 correlations which are significant with  $p < 0.001$ , and without considering all in detail, there are several interesting patterns. Only a few correlations are with the fun types although they do make sense, dancing being associated with sociability and ecstatic types of fun, whereas classical music is associated with lower sociability and higher fun from achievement, whereas pop music is associated with less fun from achievement. Amongst the attitudes, risk taking is associated not only with pop concerts and popular music and dancing, but also with museums and art galleries and with drawing and painting. Attitudes towards fun people are associated with pop concerts and discos, dancing, going to cinemas, and browsing the internet, and negatively with listening to classical music and reading novels. The attitude that fun causes happiness has a similar pattern of correlations, being positively associated with popular music, concerts, discos and dancing, and negatively associated with classical music. The importance of money for fun was associated positively with browsing the internet and negatively with reading novels. Fun in relation to spontaneity did not relate to any of the aesthetic activities.

#### 4. Discussion

“Whatever we do, we have to make it fun”, has become a modern truism and a modern cliché, applied to everything from teaching children modern languages, to

playing sport, or encouraging people to eat more fruit and vegetables. Fun however differs for different people, as was well seen in an interview with the new Registrary (the Senior Administrative Officer) of the University of Cambridge, who, when talking about the nature of academic work, said, “Fun is a word I use”, adding, “not frivolous fun though. We all spend a lot of time at work and we should make people feel they have achieved something each day and enjoy the companionship and social interaction” [41]. As Harvey [42] has put it, “having fun at work is serious business”.

However widely used is the word “fun”, and however superficially attractive it is to invoke it as a universal panacea for solving problems in life, what rapidly becomes obvious is that any statement invoking fun will inevitably beg the question of what fun is, and how fun will be recognised, and for whom. For psychologists this means attempting to provide an operational definition. What the present study makes very clear is that fun is not a simple concept. If fun is a requirement in education or other activities then some answer is required as to whose type of fun it should be. The problem is perhaps well seen in the 1994 film *Fun* (directed by Rafael Zielinski), which is described by the website [www.imdb.com](http://www.imdb.com) as “Two misfit girls meet, make friends and decide to kill an elderly woman *just for fun*” (our emphasis), and in the section of the website marked, “Fun stuff” [sic], under Quotes, is the dialogue, “I told you. Hilary and I killed the old lady just for fun. What, you want me to yell it out loud or something?” If, as seems clear, different people see fun in different ways and in different types of activity (and for some people, as a character in *Fun* puts it, “fun is not number one”), then any prescriptive attempt to

**Table 4. Correlates of scores on the five fun types and the five attitudes to fun, in relation to the amount of time spent on various cultural and aesthetic activities. Ns vary from 1051 to 1059. Key: \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ . Correlations greater than 0.1 are in bold**

	<i>Fun Type</i>					<i>Fun Attitude</i>				
	1	2	3	4	5	1	2	3	4	5
	Sociability	Contentment	Achievement	Sensual	Ecstatic	Risk taking	Fun people	Fun causing happiness	Money	Spontaneity
Listen to popular music	0.087**	-0.076*	<b>-0.118***</b>	0.036	0.029	<b>0.117***</b>	0.033	<b>0.235***</b>	0.007	0.037
Listen to classical music	-0.040	0.052	<b>0.113***</b>	-0.039	-0.052	0.048	<b>-0.149***</b>	<b>-0.122***</b>	-0.084**	-0.031
Go to pop concerts/discos	0.038	-0.080**	0.014	0.096**	0.092**	<b>0.285***</b>	<b>0.167***</b>	<b>0.121***</b>	0.036	0.053
Go to classical music concerts/ opera	<b>-0.118***</b>	0.044	0.066*	0.015	-0.039	0.032	0.043	<b>-0.109***</b>	0.038	-0.046
Play a musical instrument	-0.034	0.007	0.082**	0.008	-0.015	<b>0.095**</b>	-0.029	-0.088**	-0.010	-0.065*
Go to museums or art galleries	0.009	0.022	0.034	0.018	0.022	<b>0.121***</b>	-0.089**	-0.004	-0.059	-0.003
Read about art in newspapers, magazines or books	0.005	0.036	0.018	0.048	-0.017	0.097**	-0.048	0.005	-0.041	0.016
Draw or paint	-0.026	-0.024	0.014	0.058	0.000	<b>0.127***</b>	-0.054	-0.006	-0.057	-0.035
Read a novel	0.056	0.038	0.065	0.008	-0.087**	0.034	<b>-0.171***</b>	-0.010	<b>-0.129***</b>	-0.042
Read non-fiction books (not for work or study)	0.011	0.028	0.063*	0.050	0.018	0.102**	-0.086**	-0.059	-0.047	-0.004
Read poetry	-0.067*	0.068*	0.054	0.089**	0.006	0.073*	-0.027	-0.099**	-0.088**	0.022
Go to the cinema	-0.015	-0.019	-0.057	-0.009	0.042	0.038	<b>0.167***</b>	0.078*	0.062*	-0.002
Go to the theatres (plays/musicals, etc)	-0.002	0.010	0.014	0.064*	0.049	0.046	0.020	-0.022	0.006	-0.028
Act or otherwise take part in theatre	<b>-0.107**</b>	-0.034	-0.030	0.067*	0.004	0.072*	0.089**	-0.051	-0.011	-0.020
Go to classical or modern ballet / dance	-0.062*	0.060	-0.015	0.061*	-0.013	0.006	0.046	-0.041	-0.016	-0.066*
Go dancing (any form)	<b>0.141***</b>	-0.058	-0.050	0.102**	<b>0.164***</b>	<b>0.256***</b>	<b>0.115***</b>	<b>0.123***</b>	0.007	0.044
Watch television	-0.018	0.015	-0.015	-0.012	-0.010	-0.087**	0.062*	0.058	0.066*	-0.005
Listen to radio	-0.075*	-0.039	0.000	-0.062*	-0.066	-0.044	-0.032	0.033	-0.031	-0.007
Listen to podcasts	-0.056	-0.075*	-0.034	-0.038	0.026	0.027	0.090**	-0.024	0.058	-0.016
Browse the internet	-0.008	-0.070*	-0.064*	0.047	0.078*	0.044	<b>0.135***</b>	0.019	<b>0.109***</b>	0.019

“make something fun” is as likely as not to mean that it will not be fun for some of those taking part. Anyone who as a child or an adult has cringed at being asked publically to take part in someone else’s idea of fun which they find embarrassing or repellent will know the problem instantly. The invocation of fun is therefore not likely to be the simple panacea that its advocates might suggest, so that as always education any other activity has to provide for different people with different needs.

For an extravert a party maybe the essence of fun, while for a person high on Openness it maybe to a visit a science park, museum or gallery. Thus an agreeable, conscientious, female, middle-aged introvert may have a very different conception of fun from a young, neurotic, poorly educated, sensation-seeking male. Differential psychologists have argued that people seek out and change social activities that fit with their prefer-

ences and values. Whilst that may not necessarily label all those preferred activities as fun, it is probably a component of them. In this sense fun activities may be defined as those which satisfy various specific psychological needs for the individual. This is why the term is both subjective and multifaceted. It may therefore be useful to think of types of fun either within the Big Five factor space of trait theories or within some specific needs hierarchy such as that suggested by Murray [43].

Fun can be seen as both an attribute of a person (“they are jolly good fun”) and the property of an activity (“swimming is good fun”). The factor analysis of the fun descriptors suggests that they are being both to people and activities though some clearly fit the one better than the other. The first two factors were labelled sociability and contentment. Using personality terminology these could be interpreted in terms of stable

extraversion. Indeed, in one of the very earliest books in the area Eysenck [44] argued that “happiness is stable extraversion”. This assertion has been supported in many studies [45,46]. It is perhaps no surprise that participants’ extraversion scores were strongly positively correlated with sociability.

In this study the sensual and ecstatic factors could also be applied to people, though achievement is usually thought of more as the property of an activity. Younger, agreeable, extraverted females associated fun most with merry-making sociability, while older, open males more with flow-type achievement activities. The fun-type factor that showed most correlations with individual differences was contentment. This form of warm relaxed fun was associated with being, female, open, agreeable, introverted and stable.

Participants’ personality was also related in logical ways to the types of fun they reported. Thus young male extraverts high on openness (curiosity) but low on agreeableness and conscientiousness like risk-taking. This makes sense both in terms of the literature on personality correlates of dangerous sports and accidents [47,48]. Equally extraverts see spontaneity as an identifiable component of fun. Fun people it would appear are agreeable, open, extraverts. They would appear to have the greatest capacity for fun: seek it out, create it, enjoy it.

If one considers fun as primarily a characteristic of activities, behaviours or tasks then it appears to have various components, namely that it concerns other people in a calm, involved focused activity, as well as also being associated with physical intimacy and energetic excitement, particularly with respect to younger people. Fun thus has a cognitive dimension and an affective dimension. It can be both relaxed and exciting. The terms applied equally to both.

Attitudes towards fun are also multidimensional. Puritans clearly disapprove of fun. Studies on the Protestant Work Ethic show that they also disapprove of any activity labeled “fun” because it may be seen as time-wasting and purposeless [49]. Fun still, for many, is seen as a temporary and frivolous consolation, the business of life being serious and earnest and having little room for trivialities like fun. Clearly personality and demography predicts attitudes to fun. Young male open extraverts are clearly interested in fast, risky activities which they label as fun. It is particularly interesting that neurotics associate fun with other people while those low on both Openness and Agreeableness do not. Thus while “hell is other people” may be true for the disagreeable individual with low Openness, less stable people may find others a useful source of help and support.

This study represents the beginning of a full exploration of an important and neglected psychological

concept. For researchers it may even be suggested that researching fun can itself be rather a lot of fun.

## REFERENCES

- [1] C. D. Bryant and C. J. Forsyth, “The Fun God: Sports, Recreation, Leisure, and Amusement in the United States,” *Sociological Spectrum*, Vol. 25, No. 2, 2005, pp. 197-211.
- [2] A. E. Hamilton, “Psychology and ‘the Great God Fun’,” Julian Press, New York, 1955.
- [3] E. R. Gritz, M. K. Tripp, A. S. James, R. B. Harrist, N. H. Mueller, R. M. Chamberlain, *et al.*, “Effects of a Preschool Staff Intervention on Children’s Sun Protection: Outcomes of Sun Protection is Fun!” *Health Education and Behavior*, Vol. 34, No. 4, 2007, pp. 562-577.
- [4] R. Prigo, “Making Physics Fun: Key Concepts, Classroom Activities, and Everyday Examples, Grades K-8,” Corwin Press, Thousand Oaks, 2007.
- [5] T. Cook and E. Hess, “What the Camera Sees and from whose Perspective: Fun Methodologies for Engaging Children in Enlightening Adults,” *Childhood: A Global Journal of Child Research*, Vol. 14, No. 1, 2007, pp. 29-45.
- [6] G. Sim, S. MacFarlane and J. Read, “All Work and No Play: Measuring Fun, Usability, and Learning in Software for Children,” *Computers and Education*, Vol. 46, No. 3, 2006, pp. 235-248.
- [7] C. Angell, O. Guttersrud, E. K. Henriksen and A. Isnes, “Physics: Frightful, but Fun: Pupils’ and Teachers’ Views of Physics and Physics Teaching,” *Science Education*, Vol. 88, No. 5, 2004, pp. 683-706.
- [8] M. Davis, T. Baranowski, K. Resnicow, J. Baranowski, C. Doyle, M. Smith, *et al.*, “Gimme 5 Fruit and Vegetables for Fun and Health: Process Evaluation,” *Health Education and Behavior*, Vol. 27, No. 2, 2000, pp. 167-176.
- [9] K. A. Kendall-Tackett, “How to Write for a General Audience: A Guide for Academics who Want to Share their Knowledge with the World and Have Fun Doing it,” American Psychological Association, Washington, D.C., 2007.
- [10] L. A. Hayduk and D. N. Glaser, “Jiving the Four-Step, Waltzing around Factor Analysis, and Other Serious Fun,” *Structural Equation Modeling*, Vol. 7, No. 1, 2000, pp. 1-35.
- [11] M. Argyle, “My Secret List (Personal Communication to Adrian Furnham),” 2000.
- [12] A. Furnham, “Fortitude,” In: D. Anderson, Ed., *The Loss of Virtue*, Social Affairs Unit, London, 1992, pp. 137-153.
- [13] A. Furnham, K. Petrides and S. Spencer-Bowdage, “The Effects of Different Types of Social Desirability on the Identification of Repressors,” *Personality and Individual Differences*, Vol. 33, No. 1, 2002, pp. 119-130.
- [14] E. Deci and R. Ryan, “Intrinsic Motivation and Self-Determination in Human Behavior,” Plenum Publishing, New York, 2008.
- [15] A. Furnham, “The Psychology of Behaviour at Work,” Psychology Press, Hove, 2005.
- [16] M. Argyle, “The Psychology of Happiness,” Routledge

- Publishing, London, 2001.
- [17] D. Myers, "The Pursuit of Happiness," Avon Publications, New York, 1992.
- [18] A. Wessman and D. Ricks, "Mood and Personality," Holt, Rinehart & Winston, New York, 1966.
- [19] J. Russell, "A Circumplex Model of Affect," *Journal of Personality and Social Psychology*, Vol. 39, No. 6, 1980, pp. 1161-1178.
- [20] M. Seligman, "Authentic Happiness," Random House, London, 2003.
- [21] D. Morris, "The Nature of Happiness," Little Books, London, 2004.
- [22] A. Furnham and I. Christoforou, "Personality Traits, Emotional Intelligence, and Multiple Happiness," *North American Journal of Psychology*, Vol. 9, No. 3, 2007, pp. 439-462.
- [23] S. L. Churchill, V. L. Plano-Clark, K. Prochaska-Cue, J. W. Creswell and L. Ontai-Grzebik, "How Rural Low-Income Families Have Fun: A Grounded Theory Study," *Journal of Leisure Research*, Vol. 39, No. 2, 2007, pp. 271-294.
- [24] A. C. Garn and D. J. Cothran, "The Fun Factor in Physical Education," *Journal of Teaching in Physical Education*, Vol. 25, No. 3, 2006, pp. 281-297.
- [25] S. A. Jackson, "Joy, Fun, and Flow State in Sport," In: Y. L. Hanin, Ed., *Emotions in Sport*, Human Kinetics Publishers, Champaign, 2000, pp. 135-155.
- [26] J. A. Middleton, J. Littlefield and R. Lehrer, "Gifted Students' Conceptions of Academic Fun: An Examination of a Critical Construct for Gifted Education," *Gifted Child Quarterly*, Vol. 36, No. 1, 1992, pp. 38-44.
- [27] J. A. Middleton, "A Study of Intrinsic Motivation in the Mathematics Classroom: A Personal Constructs Approach," *Journal for Research in Mathematics Education*, Vol. 26, No. 3, 1995, pp. 254-279.
- [28] D. C. Slaughter, "A Fun Scale and its Possible Applications," *Dissertation Abstracts International*, Vol. 44, 1984, pp. 3577-3578.
- [29] I. C. McManus, "Measuring the Culture of C. P. Snow's Two Cultures," *Empirical Studies of the Arts*, Vol. 24, No. 2, 2006, pp. 219-227.
- [30] I. C. McManus and A. Furnham, "Aesthetic Activities and Aesthetic Attitudes: Influences of Education, Background and Personality on Interest and Involvement in the Arts," *British Journal of Psychology*, Vol. 97, No. 4, 2006, pp. 555-587.
- [31] A. Furnham and H. Cheng, "Lay Theories of Happiness," *Journal of Happiness Studies*, Vol. 1, No. 2, 2000, pp. 227-246.
- [32] A. Furnham, H. Cheng and Y. Shirasu, "Lay Theories of Happiness in the East and West," *Psychologia*, Vol. 44, No. 2, 2001, pp. 173-187.
- [33] J. Pflug, "Folk Theories of Happiness," *Social Indicators Research*, Vol. 92, No. 3, 2009, pp. 551-563.
- [34] A. Furnham, I. C. McManus and D. Scott, "Personality, Empathy and Attitudes to Animal Welfare," *Anthrozoös*, Vol. 16, No. 2, 2003, pp. 135-146.
- [35] A. Furnham and I. C. McManus, "Student Attitudes to University Education," *Higher Education Review*, Vol. 36, No. 2, 2004, pp. 29-38.
- [36] R. A. Fox, I. C. McManus and B. C. Winder, "The Shortened Study Process Questionnaire: An Investigation of its Structure and Longitudinal Stability Using Confirmatory Factor Analysis," *British Journal of Educational Psychology*, Vol. 71, No. 4, 2001, pp. 511-530.
- [37] C. Mackay, T. Cox, G. Burrows and T. Lazerini, "An Inventory for the Measurement of Self-Reported Stress and Arousal," *British Journal of Social and Clinical Psychology*, Vol. 17, No. 3, 1978, pp. 283-284.
- [38] G. Matthews, D. M. Jones and A. G. Chamberlain, "Refining the Measurement of Mood: The UWIST Mood Adjective Checklist," *British Journal of Psychology*, Vol. 81, 1990, pp. 17-42.
- [39] T. J. Huelsman and R. C. Nemanick, "Scales to Measure Four Dimensions of Dispositional Mood: Positive Energy, Tiredness, Negative Activation, and Relaxation," *Educational and Psychological Measurement*, Vol. 58, No. 5, 1998, pp. 804-819.
- [40] L. Dubé and J. L. Le Bel, "The Content and Structure of Laypeople's Concept of Pleasure," *Cognition and Emotion*, Vol. 17, No. 2, 2003, pp. 263-295.
- [41] Anonymous, "Creating a Culture of Change (Interview with Dr. Jonathan Nicholls)," *CAM: The University of Cambridge Alumni Magazine*, No. 53, 2008, p. 9.
- [42] A. Gostick and S. Christopher, "Having Fun at Work is Serious Business," *PsycCRITIQUES*, Vol. 53, No. 41, 2008, pp. 1-3.
- [43] H. A. Murray, "Explorations in Personality," Oxford University Press, Oxford, 1938.
- [44] H. J. Eysenck, "I Do: Your Guide to a Happy Marriage," Century Publishing, Post Falls, 1983, pp. 1-217.
- [45] L. J. Francis, L. B. Brown, D. Lester and R. Philipchalk, "Happiness as Stable Extraversion: A Cross-Cultural Examination of the Reliability and Validity of the Oxford Happiness Inventory among Students in the U.K., U.S.A., Australia, and Canada," *Personality and Individual Differences*, Vol. 24, No. 2, 1998, pp. 167-171.
- [46] A. Furnham and C. Brewin, "Personality and Happiness," *Personality and Individual Differences*, Vol. 11, No. 10, 1990, pp. 1093-1096.
- [47] M. Zuckerman, "P-Impulsive Sensation Seeking and its Behavioral, Psychophysiological Biochemical Correlates," *Neuropsychobiology*, Vol. 28, No. 1-2, 1993, pp. 30-36.
- [48] M. Zuckerman, "Behavioral Expressions and Biosocial Bases of Sensation Seeking," Cambridge University Press, Cambridge, 1994.
- [49] A. Furnham, "The Protestant Work Ethic," Routledge Publishing, Cornwall, 1990.

# Life Events and Psychoeducation in Patients with Systemic Sclerosis

Yue Chen<sup>1\*</sup>, Jizhong Huang<sup>2</sup>, Yu Qiang<sup>2</sup>, Maomao Han<sup>1</sup>, Shichao Liu<sup>1</sup>, Chunlan Cui<sup>1</sup>

<sup>1</sup>Department of Geriatrics, the First Affiliated Hospital, School of Medicine, Zhejiang University, Hangzhou, China; <sup>2</sup>Department of Rheumatology, Hangzhou Tongji Hospital, Hangzhou, China.  
Email: lxling@mail.hz.zj.cn

Received April 8<sup>th</sup>, 2010; revised June 9<sup>th</sup>, 2010; accepted June 11<sup>th</sup>, 2010.

## ABSTRACT

**Objective:** The purpose of this study was to assess the impact of psychological/psychoeducational assessment in patients with systemic sclerosis (SSc). **Methods:** A diagnostic interview was undertaken in order to investigate any temporal connection between an adverse life event and the first appearance of SSc. Following this, the rheumatologist's assessment of subsequent changes in the SSc were noted. The psychoeducation we did, as an adjunct to conventional thoracic duct lymphatic drainage therapy (TDD), started in Dec. 2002, and the primary end point was an improvement in clinical outcome at 1 month after entry. **Results:** The patients with SSc in the study showed higher percentages of lower education (69.2%) and working class (63.5%), and reported that the most common life event in adults was divorce or separation from spouse, while in adolescent was difficult home conditions. A favourable response was noted in all patients who participated in the study; Remission was achieved in 35, while 17 showed some improvement. **Conclusions:** We conclude that life events were causally related to the onset of SSc and psychoeducation combined with conventional TDD led to a remission in the majority of patients.

**Keywords:** Psychosomatic Medicine, Systemic Sclerosis (SSc), Life Events, Psychoeducation

## 1. Introduction

Systemic sclerosis (SSc) is a systemic connective tissue disease and a chronic and potentially life threatening condition characterized by vascular abnormalities and fibrosis of the skin and multiple organs [1]. Many factors, such as environmental factors, can lead to immunologic system disturbances and vascular changes. It has been reported on our previous research that social and psychological stresses may trigger these disturbances and changes [2], and conventional thoracic duct lymphatic drainage therapy (TDD) for the SSc patients has been proven effective [3]. Few data relating to a precise psychological event or events underlying the onset of SSc are available, and this study was set up to determine whether life events had been causally related to the onset of SSc and to determine whether psychoeducation combined with TDD had led to an improvement in the SSc.

## 2. Patients and Methods

### 2.1 Patients

A total of 52 patients with SSc (mean age  $53.6 \pm 10.2$

years, mean disease duration  $3.8 \pm 2.3$  years), including 33 with diffuse cutaneous scleroderma and 19 with limited cutaneous scleroderma, were included in the study. Patients were admitted to the Department of Internal Medicine in the First Affiliated Hospital, Zhejiang University Medical School, Hangzhou, China, between December 2002 and October 2009 for a routine follow-up evaluation of SSc. Their diagnoses of SSc met the American College of Rheumatology criteria [4]. For these patients, the following epidemiological data were recorded: age, disease duration, previous psychopathology, current treatments, and socioeconomic status. Scleroderma was further categorized as diffuse or limited scleroderma as defined by LeRoy *et al.* [5]. Goldthorpe and Hope's [6] occupational classification was used to distribute the patients into two categories (middle-upper social class and working class), and their education levels also were evaluated [7]. The psychoeducation we did, as an adjunct to conventional TDD, started in Dec. 2002, and all 52 patients who signed informed consent form, were on TDD with a satisfactory efficacy.

## 2.2 Investigation of Life Events and Psychoeducation

A brief life-history was obtained in all cases. The emphasis was on the previous health of the patient or members of the immediate family, death of anyone close to the patient, difficulties experienced during different periods of their life, their relationships with others in the family, at school or at work, problems with friends, their hopes and ambitions. A mother's undue concern for her child, learning difficulties (due to visual or auditory disability or dyslexia) and unsatisfactory scholastic achievement, stability of marriage, change in job conditions, adjustment to retirement, isolation and loneliness may be of importance. If a possible connection between an event and the onset of the SSc was identified, its importance was discussed in detail with the patient. Each patient also underwent a psychiatric assessment to look for the presence / a history of psychiatric illness. The salient features of the history were reported to the rheumatologist, who saw the patient again and concluded the consultation, in order to reassure the patient that their problem was rheumatological.

## 2.3 Assessment of Outcome

All assessments as to clinical outcome were carried out by the responsible rheumatologist in simple terms of remitted, improved, and not improved or on-going [3]. They were based on his previous experience with the patient, estimation of the degree of reduction of symptoms and disability, the ability to return to normal activities and the quality of life of the patient. The psychiatrist was also involved in the final assessment.

## 3. Results

### 3.1 Patient Characteristics

The entire sample in the study was composed of 52 patients with a mean age of  $53.6 \pm 10.2$  years and a mean disease duration of  $3.8 \pm 2.3$  years. The female-to-male ratio was about 4:1. **Table 1** reports the main clinical and laboratory test features and family status. All 52 patients were on TDD with a satisfactory efficacy. None of the patients was receiving psychiatric care at the time of the study.

### 3.2 Significant Life Events

A significant life event was identified in 45 out of the total of 52 patients; this was usually associated with a

good outcome. The most common life events in adults and in children and young patients are listed in **Box 1**.

### 3.3 Clinical Outcome

The outcome was favourable in all 52 patients (**Table 2**). A favourable outcome was classified as remitted (full and satisfactory response leading to early discharge),

#### Box 1. The most common life events in adults and in children and young patients

##### Significant life events

##### In adults:

- divorce or separation from spouse
- incapacitating illness in patient or close relative
- a bereavement seriously affecting the patient
- moving to new surroundings

##### In children and young patients:

- difficult home conditions
- serious school difficulties, eg, math calculation
- isolation at home or school

**Table 1. Demographic characteristics of the patients with SSc**

	N = 52
<b>Cutaneous involvement</b>	
Diffuse	33
Limited	19
Arthritis	10
Skin ulcers	8
Esophageal involvement	14
Pulmonary fibrosis (computed tomography)	19
Forced vital capacity < 80%	12
Antinuclear antibodies	15
Anti-Scl 70 antibodies	12
Serum creatinine, mean $\pm$ S.D. ( $\mu$ mol/L)	$76 \pm 10$
Erythrocyte sedimentation rate, mean $\pm$ S.D.(mm/h)	$28 \pm 13$
C-reactive protein, mean $\pm$ S.D.(mg/L)	$21 \pm 8$
<b>Family status</b>	
Spouse or living partner	31
Alone	21
Children at home	23
Paid job	29
13+yr of education	16
Lower education	36
Middle-upper social class	11
Working class	33

**Table 2. Clinical outcome of SSc patients at 1 month after treatment**

Therapeutic strategy	No of patients	Sex (F:M)	Age range (years)	Remitted	Improved	Not improved
TDD combined therapy	52	40:12	15~69	35	17	0

improved (condition improved but discharge without supervision not possible), or not improved [3]. These patients tended to respond favourably to psychoeducation combined with TDD (35/52 patients), indicating the TDD plus psychoeducational intervention being a better solution to SSc.

### 3.4 Psychological Diagnosis

Psychological diagnoses [8] (**Table 3**) showed the usual range of disorders seen in a group of patients, with the largest number being in the minor depressive and anxiety category (17 patients). However, no psychological diagnosis was evident in 11 patients. Psychoses were found in four patients. Psychological diagnoses were scattered among the various subtypes of SSc without any particular pattern. No relationship was identified between the psychological diagnosis and clinical types of SSc.

## 4. Discussion

Although what causes SSc still is not very clear yet, many now agree that the disease may occur when the immune system becomes disordered, attacking the myelin surrounding nerve fibers. Focusing on biology, researchers suspect these attacks may initially be triggered by infection with a virus, perhaps picked up early in life. However, social and psychological factors are well-documented to play a role in the causation of immune disorders, and there might be a connection of stress to SSc as well [2]. An adverse life event may be important in understanding the mode of onset of SSc. Such an event may be one that the individual has construed as being threatening, damaging, or even dangerous, and for which there appears to be no solution. This experience of an adverse life event may result in distress and /or conflict leading to mental or physical change or a combination of the two. In the latter instance it has become customary to speak of a psychosomatic disorder [9].

Emotional reactions to the significant life events(box1) are inevitable, and they often have serious effects on the patient and his family. In many cases they may be responsible for the onset of SSc in terms of suffering that is greater than that caused by the physical effects of SSc [10]. Emotional disturbance may be particularly severe and prolonged if the patient fails to receive adequate counselling and support. The emotional and relationship problems associated with SSc have not always been fully appreciated by the medical profession, which has tended to concentrate on the physical effects of this disease [11]. Yet the psychological problems of SSc often cause more suffering than the physical effects. We recommend that more attention should be paid to this aspect of the disease in terms of both clinical care and research [2].

In the study, most of the SSc patients tended to respond favourably to our psychoeducational intervention (35 patients), which served as an adjunct to conventional

TDD therapy. In the patients showing a good response, a new optimism emerged rapidly and they were both satisfied and confident. Inquiry from a relative or friend confirmed this impression. The possible factors contributing to the improvements are listed in **Box 2**. By increased insight we mean enhanced self-knowledge and a better understanding by the patient of circumstances prevailing at the time of the onset of the SSc.

The conclusion that emerges from this study is that an adverse life event had continued to affect the emotional state of nearly four-fifths of the patients with SSc and this in turn played a major role in the progress of the disorder and its resistance to treatment. However, no relationship was identified between the psychological diagnosis and clinical types of SSc. Such a psychological intervention could usefully be included in the normal SSc assessment, as it should both improve patient care and be cost effective [12]. To our knowledge this is the first research yet in China from a rheumatology-psychiatry liaison team [13]. The procedure described above has a simplicity and commonality which may recommend it for further consideration and research.

## 5. Acknowledgements

This study was supported by grant No. B340406052 from the Science and Technology Foundation of Shanghai Railway Bureau (Hangzhou, China) to Drs. Huang and Chen.

**Table 3. Psychological diagnosis**

Diagnosis	n
Psychosis:	
Major depressive disorder	3
Delusional disorder	1
Minor depressive or anxiety disorder	17
Bereavement	6
Psychosocial problems	9
Clinical disorder (ie, psychological concern over a medical illness)	5
No diagnosis	11

### Box 2. The possible factors contributing to the improvements

Factors contributing to improvements
·increased insight
·opportunity to talk and ask question
·evidence of emotional reaction during interview
·attention received
·the power of suggestion
·placebo effect

We are grateful to Dr. Qie Hong-li for her helpful comments on the paper.

### REFERENCES

- [1] V. D. Steen and T. A. Medsger, "Severe Organ Involvement in Systemic Sclerosis with Diffuse Scleroderma," *Arthritis & Rheumatism*, Vol. 43, No. 11, 2000, pp. 2437-2444.
- [2] Y. Chen, J. Z. Huang, Y. Qiang, J. Wang and M. M. Han, "Investigation of Stressful Life Events in Patients with Systemic Sclerosis," *Journal of Zhejiang University Science B*, Vol. 9, No. 11, 2008, pp. 853-856.
- [3] J. Z. Huang and J. Zhu, "Thoracic Duct Drainage Therapy," Chinese Publishing House of International Broadcast, Beijing, 1991, pp. 217-223.
- [4] A. T. Masi, G. P. Rodnan and T. A. Medsger, "Preliminary Criteria for the Classification of Systemic Sclerosis (Scleroderma)," *Arthritis & Rheumatism*, Vol. 23, No. 5, 1980, pp. 581-590.
- [5] E. C. LeRoy, C. Black and R. Fleischmajer, "Scleroderma (Systemic Sclerosis): Classification, Subsets, and Pathogenesis," *Journal of Rheumatology*, Vol. 15, No. 2, 1988, pp. 202-205.
- [6] J. H. Goldthorpe and K. Hope, "The Social Grading of Occupations," Oxford University Press, Oxford, 1974, pp. 235-238.
- [7] B. Archenholtz, E. Nordborg and T. Bremell, "Lower Level of Education in Young Adults with Arthritis Starting in the Early Adulthood," *Scandinavian Journal of Rheumatology*, Vol. 30, No. 6, 2001, pp. 353-355.
- [8] American Psychiatric Association, "Mental Disorders," 4th Edition (DSM-IV), APA, Washington, D.C., 1994.
- [9] C. C. Chen, A. S. David and H. Nunnerly, "Adverse Life Events and Breast Cancer: Case Control Study," *British Medical Journal*, Vol. 311, No. 7019, 1995, pp. 1527-1530.
- [10] S. R. Dube, D. Fairweather, W. S. Pearson, V. J. Felitti, R. F. Anda and J. B. Croft, "Cumulative Childhood Stress and Autoimmune Diseases in Adults," *Psychosomatic Medicine*, Vol. 71, No. 2, 2009, pp. 243-250.
- [11] U. M. Anderberg, I. Marteinsdottir, T. von Theorell and L. Knorring, "The Impact of Life Events in Female Patients with Fibromyalgia and in Female Healthy Controls," *European Psychiatry*, Vol. 15, No. 5, 2000, pp. 295-301.
- [12] T. N. Hyphantis, N. Tsifetaki, C. Pappa, P. V. Voulgari, V. Sifaka and M. Bai, "Clinical Features and Personality Traits Associated with Psychological Distress in Systemic Sclerosis Patients," *Journal of Psychosomatic Research*, Vol. 62, No. 1, 2007, pp. 47-56.
- [13] K. Mulligan and S. Newman, "Psychoeducational Interventions in Rheumatic Diseases: A Review of Papers Published from September 2001 to August 2002," *Current Opinion in Rheumatology*, Vol. 15, No. 2, 2003, pp. 156-159.

# Breakup Distress and Loss of Intimacy in University Students

Tiffany Field<sup>1,2</sup>, Miguel Diego<sup>1</sup>, Martha Pelaez<sup>3</sup>, Osvelia Deeds<sup>3</sup>, Jeannette Delgado<sup>1</sup>

<sup>1</sup>Department of Pediatrics, University of Miami Medical School, Miami, USA; <sup>2</sup>Fielding Graduate University, Santa Barbara, USA;

<sup>3</sup>Department of Psychology, Florida International University, Miami, USA.

Email: [tfield@med.miami.edu](mailto:tfield@med.miami.edu)

Received May 26<sup>th</sup>, 2010; revised July 3<sup>rd</sup>, 2010; accepted July 6<sup>th</sup>, 2010.

## ABSTRACT

*Breakup distress and reasons for breakup including affiliation, intimacy, sexuality and autonomy reasons were studied in 119 university students who had experienced a recent breakup of a romantic relationship. The sample was divided into high and low breakup distress groups based on a median score on the Breakup Distress Scale. The groups were then compared on their responses on the Breakup Reasons Scale. Only the intimacy subscale differentiated the high versus low breakup distress groups. These data highlight the importance of intimacy for romantic relationships and the loss of intimacy as a reason for breakups.*

**Keywords:** Intimacy, University Students, Breakup Distress

## 1. Introduction

Breakup distress in university students has been related to several factors. Breakup distress has been greater for those who attributed the breakup to the other person (e.g. the partner's mood or insensitivity) or to environmental factors (e.g. work stress or friends being disruptive to the relationship) [1]. Breakup distress in university students has also been related to global negative beliefs about the self and cognitions reflecting self-blame [2].

In a study we conducted, university students who had high Breakup Distress Scale scores reported: 1) not initiating the breakup; 2) that the breakup was sudden and unexpected; 3) that they felt rejected and betrayed; 4) that they had less time since the breakup occurred; and 5) that they had not yet found a new relationship [3]. In this study, university students who had experienced a recent breakup of a romantic relationship were divided into high versus low score groups based on the Breakup Distress Scale. Females had higher Breakup Distress Scale scores. Students with high breakup distress scores also scored higher on the Intrusive Thoughts Scale, the Difficulty Controlling Intrusive Thoughts Scale, the Sleep Disturbances Scale and on depression and anxiety scales. In a regression analysis, the most important predictors of the breakup distress scores were depression, feeling betrayed by the breakup, shorter time since the breakup occurred and a higher rating of the relationship prior to the breakup. This explained as much as 37% of the variance,

suggesting that these factors are important contributors to relationship breakup distress, but also suggesting that a large part of the outcome variance was not yet explained. In another study on college students, the closeness and the duration of the broken relationship predicted the intensity and the duration of emotional distress following the breakup [4]. At least one other investigator reported that greater levels of love were associated with a decreased probability of recovering from the breakup [5].

Fewer studies have been conducted on the reasons for romantic breakups. In a longitudinal study, the primary reason for breakup among college students was unequal involvement in the relationship [6]. This phenomenon may be similar to the "romantic disengagement" preceding breakups reported by others [7]. In that study, romantic disengagement, in turn, was negatively related to intimacy, suggesting the breakdown of intimacy as a reason for breakups.

The reasons for breakups and how they relate to breakup distress were the primary focus of the current study. One might argue that the reasons for breakup may be the loss of important qualities of the relationship. Collins [8] suggested that romantic relationships provide a context for the maturation of intimacy, affiliation, sexuality and autonomy. Breakups are also related to these factors [9]. As these authors noted, "the initiation of a romantic relationship in adolescence is propelled by the combination of a young person's emerging need for sexuality with a

heightened need for intimacy with non-familiar others” [9]. The intimacy needs involve emotional closeness with a partner including having trust, understanding, disclosure and the mutual expression of loving feelings. The need for affiliation is thought to include companionship, spending time together and sharing activities. And, the sexuality needs are thought to include sexual attraction and physical affection. Some have suggested that there is an age-related decrease in the focus on affiliative and sexual dimensions of relationships with a greater focus on intimacy [10].

In a study on breakup reasons, high school students were asked to provide a written response to the question “What was the most important reason why your last romantic relationship ended?” [9]. The adolescents’ explanations for the breakups were then reviewed and coded using a categorical-content qualitative analysis method [11]. The authors suggested that since the responses were brief, they were assigned a code for the hypothesized content-categories of intimacy, affiliation, sexuality, identity and autonomy. The affiliation category included breakup reasons like no time together, boredom, and disinterest while the intimacy category included items like absence of love, distrust/dishonesty, poor communication and poor treatment. Sexuality items included sexual dissatisfaction and lack of physical attraction. The authors found that problems with affiliation (44%) and intimacy (36%) were more prevalent in adolescents’ breakup accounts than were problems with sexuality (20%). One of the problems of this study, as was acknowledged by its authors, was that the students were only being asked to give the most important reason for the breakup when in fact the breakup may have occurred for many reasons, some big, some small. In addition, the qualitative method limits the power of the data analysis. Nonetheless, the data are highly suggestive and were used as the foundation for the current study.

In the present study, a Breakup Reasons Scale was created from many of the items from the Connelly and McIsaac [9] study and was administered to university students. In addition, to determine how breakup reasons vary by breakup distress, the Breakup Distress Scale was administered, and the sample was divided into high and low distress groups based on a median split on that scale. The groups were then compared on the Breakup Reasons scale total score and the subscale scores labeled affiliation, intimacy, sexuality and autonomy. Other ratings were also completed as potential confounding variables including ratings on the relationship, the partner and the ideal relationship.

## 2. Methods

### 2.1 Participants

The initial sample was 156 students (N = 112 females)

who were recruited at a southeastern university. Of this sample, 119 (76%) had experienced a breakup 3.5 months ago on average after a relationship that averaged 3.3 months duration. The students had experienced 2.9 breakups on average, 2.0 of them having been with the same partner. The breakup sample was divided into high and low breakup distress groups based on a median split on the Breakup Distress Scale. No differences were noted between the two groups on demographic variables (ethnicity, age, and grade) except for gender. For the high and low distress groups respectively: 1) age averaged 24.2 and 24.4; 2) grade averaged 13.6 and 13.3; and 3) ethnicity was distributed Hispanic (75% and 80%), Caucasian (9% and 13%), African-American (6% and 2%) and other (10% and 5%) (all *ps* non-significant). The high Breakup Distress Scale score group had more females than the low distress group (86% vs. 68%,  $\chi^2 = 5.67$ ,  $p < .02$ ), and females had higher scores on the Breakup Distress Scale (M = 10.2 vs. 7.1,  $F = 6.41$ ,  $p = .01$ ).

### 2.2 Procedures

The students were recruited for this anonymous questionnaire study from psychology classes and given extra credit for their participation. During one of their class sessions, the students completed a questionnaire that was comprised of demographic questions, the Breakup Distress Scale, the Breakup Reasons Scale, and ratings on their relationship before the breakup, how much they missed their partner and what they viewed as the ideal relationship.

### 2.3 Measures

The Breakup Distress Scale (BDS) [3] was adapted from the Inventory of Complicated Grief (ICG) [12]. Based on that study, the internal consistency of the 19-item ICG was high (Cronbach’s  $\alpha = 0.94$ ).

The Breakup Distress Scale was adapted from the ICG by referring to the breakup person instead of the deceased person, and only 16 of the 19 ICG items that were appropriate to breakups were included. A different rating scale was also used, *i.e.* a Likert scale with responses ranging from 1 (not at all) to 4 (very much so) including: 1) I think about this person so much that it’s hard for me to do things I normally do; 2) Memories of the person upset me; 3) I feel I cannot accept the breakup I’ve experienced; 4) I feel drawn to places and things associated with the person; 5) I can’t help feeling angry about the breakup; 6) I feel distressed about what happened; 7) I feel stunned or dazed over what happened; 8) Ever since the breakup it is hard for me to trust people; 9) Ever since the breakup I feel like I have lost the ability to care about other people or I feel distant from people I care about; 10) I have been experiencing pain since the breakup; 11) I go out of my way to avoid reminders of the

person; 12) I feel that life is empty without the person; 13) I feel bitter over this breakup; 14) I feel envious of others who have not experienced a breakup like this; 15) I feel lonely a great deal of the time since the breakup; and 16) I feel like crying when I think about the person. The internal consistency of this 16-item scale was also high ( $\alpha = .91$ ).

Other ratings were used to address relationship variables that might confound the breakup distress experience. These included rating the relationship as it was before the breakup, rating what the student missed about the partner, and the student's view of an ideal relationship.

The Breakup Reasons Scale (BRS) is a 20-item scale that was developed for this study based on the qualitative study done on high school students' explanations for their romantic breakups [9]. As already mentioned, they identified five categories of breakup reasons including intimacy, affiliation, sexuality, autonomy and identity. The scale used in this study included subscales on 8 intimacy items, 7 affiliation items, 3 sexuality items and 2 autonomy items. Each of these items was rated on a 4-point Likert scale. These items appear in **Table 1**. The internal consistency for this 20-item scale was high ( $\alpha = .93$ ). The alphas for the subscales were moderate to

high (intimacy = .84, affiliation = .79, sexuality = .71; autonomy = .67).

The Relationship ratings included 5 items rated on a 4 point Likert scale including rating of the relationship from 1 (ok) to 4 (wonderful). The other items were rated from 1 (not at all) to 4 (very much so) including: 1) did you and your partner share a lot of activities/interests together? 2) did you and your partner share a lot of your thoughts and feelings together? 3) did you and your partner show a lot of affection toward each other? and 4) did and your partner have a lot of disagreements? (reverse scored). These were then totaled for a summary rating.

The Missing the Partner ratings were also made on a Likert scale from 1 (totally disagree) to 4 (totally agree). The items read, after the breakup: 1) I missed our daily activities/rhythms; 2) I missed our talking/emotional closeness; and 3) I missed our touching/physical closeness. These were added for a total rating.

The Ideal Relationship ratings were also made on a Likert rating scale from 1 (almost never) to 4 (almost always). The 11 items included "behaviors that you look for in an ideal relationship" including: 1) Sharing favorite activities; 2) A reciprocal relationship that is fair and balanced; 3) A calming influence; 4) Nurturing behavior;

**Table 1. Mean subscale and total scores on the Breakup Reasons Scale (standard deviations in parentheses) for low and high distress groups and items of each subscale**

	Groups		F	p
	Low Distress	High Distress		
<u>Intimacy</u>	15.70 (6.18)	20.04(5.73)	14.41	.000
Poor communication	2.40 (1.23)	2.81 (1.18)		
Distrust	2.13 (1.14)	2.85 (1.24)		
Unreciprocated love	1.70 (0.88)	2.42 (1.18)		
Non-caring behavior	1.85 (0.99)	2.50 (1.14)		
Diminishing empathy	1.82 (1.16)	2.22 (1.05)		
Arguments	2.27 (1.16)	2.71 (1.25)		
Infidelity	1.82 (1.16)	2.24 (1.05)		
Hypersensitivity	1.76 (0.94)	2.24 (1.05)		
<u>Affiliation</u>	14.28 (5.47)	14.81 (5.49)		NS
Boredom	2.16 (1.10)	2.08 (1.16)		
Lack of time together	1.98 (1.16)	2.32 (1.14)		
Dissimilar interests	2.09 (1.08)	1.92 (1.06)		
Dissimilar traits	1.96 (1.14)	2.17 (1.18)		
Diminishing fun	2.13 (1.10)	2.16 (1.09)		
Diminishing excitement.	2.20 (1.13)	2.17 (1.07)		
Increasing time during other activities	1.93 (1.09)	2.14 (1.05)		
<u>Sexuality</u>	5.71 (2.79)	6.00 (2.76)		NS
Sexual dissatisfactions	1.82 (1.09)	2.15 (1.16)		
Diminishing physical attraction	1.96 (1.14)	1.88 (1.04)		
Diminishing physical affection	1.93 (1.05)	1.97 (1.08)		
<u>Autonomy</u>	3.96 (1.90)	4.46 (1.98)		NS
Problem maintaining independent self	1.89 (1.04)	2.19 (1.17)		
Control	2.07 (1.18)	2.27 (1.22)		
<u>Total score</u>	17.28 (12.79)	23.75 (11.97)	7.71	.006

5) Allowing for my independence/room to breathe; 6) Interesting conversations; 7) Exciting experiences; 8) Humorous/fun-loving; 9) Positive/upbeat; 10) Sexually satisfying and 11) Physically attractive. These were then totaled for a summary rating.

### 3. Results

ANOVAs were conducted on the Breakup Reasons subscales. As can be seen in **Table 1**, the total score for the intimacy subscale significantly differentiated the high distress from the low distress groups. This subscale included poor communication, distress, unreciprocated love, non-caring behavior, diminishing sympathy, arguments, infidelity and hypersensitivity. Although no group differences were noted on the affiliation, sexuality and autonomy subscales, the total score for the Breakup Reasons Scale was also higher for the high distress group. A correlation analysis suggested the following significant relationships between the subscales and the total Breakup Reasons Scale score: 1) intimacy = 0.79; 2) affiliation = 0.66; 3) sexuality = 0.53; and 4) autonomy = 0.61 (all  $p$ s < 0.05).

As can be seen in **Table 2**, ANOVAs on the other ratings on potentially confounding variables yielded significant differences between groups including n: 1) the Relationship Ratings on the relationship prior to the breakup; and 2) Missing the Partner Ratings. The groups did not differ on the Ideal Relationship Rating.

### 4. Discussion

The primary finding that decreasing intimacy was a factor in high breakup distress is perhaps not surprising given that intimacy was a primary reason for breakups in at least one other sample [9]. In that study, 36% of the adolescents' responses were coded as intimacy-related, and romantic intimacy was defined in terms of establishing a high degree of emotional closeness with a partner, supported by such processes as trust, understanding, disclosure and the mutual expression of loving feelings. Others have described intimacy similarly [13,14]. And, others have referred to the lack of intimacy as disengagement and have reported that disengagement contri-

buted to the breakup itself as well as to greater breakup distress [7]. In the present study the lacking intimacy items included poor communication, distrust, unreciprocated love, non-caring behavior, diminishing empathy, arguments, infidelity and hypersensitivity.

Surprisingly, the affiliation, sexuality and autonomy items did not differentiate the high from the low breakup distress groups. Affiliation was cited by 44% of the adolescents in the Connelly and McIsaac study [9] as being the primary reason for romantic breakups, and sexuality was given as the primary reason by 20% of their sample. The literature, however, appears to be inconsistent about the importance of these reasons for breakup. In another study on adolescents, an age-related decline was noted on the focus on sexual and affiliative dimensions of relationships in favor of focusing more on intimacy factors [10]. In contrast, at least one other investigator has noted that sexual dissatisfaction, boredom with the relationship and a lack of reciprocated love were important causes of the termination of relationships [15]. In addition, autonomy problems including partner dissimilarity and different work styles were also explanations in that study [15] and in another study [6].

Potential confounding variables differentiated the high distress from the low distress group including the Relationship rating and the Missing the Partner rating. These findings are consistent with previous research reporting greater emotional distress following break-ups of closer relationships [4] and relationships with "greater levels of love" [5].

It was not surprising that the Ideal Relationship Rating scale did not differentiate the groups. Whether the students had high or low breakup distress scores, their ratings of ideal relationships were similar.

One of the expected findings was that a significantly greater number of women than men were in the high distress group. This finding is consistent with earlier studies [3,16]. Women are notably more reactive to interpersonal stress and more likely to become depressed following an interpersonal stressor [17]. As those authors suggested, women possibly place more importance on harmonious relationships [18]. Women are also twice as likely as men to be depressed [19]. Those authors noted that this difference might be related to different cognitive styles and greater chronic stress in women [20].

In summary, although this study was focused on replicating a high school student study on romantic breakups but with university students and using a scale instead of an open-ended questionnaire, and quantitative rather than qualitative methods, the only factor on the Breakup Reasons Scale that differentiated high from low breakup distress groups was the intimacy factor. But, as was seen, other variables also differentiated high and low breakup distress groups including the relationship ratings and missing the person ratings, feelings that may have de-

**Table 2. Mean ratings on other variables differentiating the low and high breakup distress groups (standard deviations in parentheses)**

Variable	Groups		F	p
	Low Distress	High Distress		
Relationships Rating	7.91 (3.34)	9.61 (3.00)	10.21	.002
Missing the Partner	3.27 (2.72)	5.71 (2.72)	22.88	.000
Ideal Relationship Rating	25.20 (8.43)	26.38 (5.46)	NS	NS

rived from the breakup rather than contributing to the breakup.

Larger samples are needed to study multiple variables, not just self-report measures, and to conduct regression and structural equations analyses to determine the relative contribution of these variables to breakup reasons and breakup distress and their relationships to each other. In addition, positive effects such as breakup distress-related growth [1,21] need further study. Finally, research on partners' interactions prior to the breakup could reveal the qualities that were critical to the relationship, qualities such as intimacy that disappeared and led to the breakup and the breakup distress.

## 5. Acknowledgements

We thank the students who participated in this study and the research associates who assisted us. Correspondence and requests for reprints should be sent to Tiffany Field, Ph.D., Touch Research Institute, University of Miami School of Medicine, PO Box 016820, Miami, Florida, 33101. Business phone number (305) 243-6781.

## REFERENCES

- [1] T. Y. Tashiro and P. Frazier, " 'I'll Never be in a Relationship Like that Again': Personal Growth Following Romantic Relationship Breakups," *Personal Relationships*, Vol. 10, No. 1, 2003, pp. 113-128.
- [2] P. A. Boelen and A. Reijntjes, "Negative Cognitions in Emotional Problems Following Romantic Relationship Break-Ups," *Stress and Health*, Vol. 25, No. 1, 2009, pp. 11-19.
- [3] T. Field, M. Diego, M. Pelaez, O. Deeds and J. Delgado, "Breakup Distress in University Students," *Adolescence*, Vol. 44, No. 176, 2009, pp. 705-727.
- [4] J. A. Simpson, "The Dissolution of Romantic Relationships: Factors Involved in Relationship Stability and Emotional Distress," *Journal of Personality and Social Psychology*, Vol. 53, No. 4, 1987, pp. 683-692.
- [5] D. A. Sbarra, "Predicting the Onset of Emotional Recovery Following Nonmarital Relationship Dissolution: Survival Analyses of Sadness and Anger," *Personality and Social Psychology Bulletin*, Vol. 32, No. 3, 2006, pp. 298-312.
- [6] C. T. Hill, Z. Rubin and L. A. Peplau, "Breakups before Marriage: The End of 103 Affairs," *Journal of Social Issues*, Vol. 32, No. 1, 1976, pp. 147-168.
- [7] R. A. Barry, E. Lawrence and A. Langer, "Conceptualization and Assessment of Disengagement in Romantic Relationships," *Personal Relationships*, Vol. 15, No. 3, 2008, pp. 297-315.
- [8] W. A. Collins, "More than Myth: The Developmental Significance of Romantic Relationships during Adolescence," *Journal of Research on Adolescence*, Vol. 13, No. 1, 2003, pp. 1-24.
- [9] J. Connelly and C. McIsaac, "Adolescents' Explanations for Romantic Dissolutions: A Developmental Perspective," *Journal of Adolescence*, Vol. 32, No. 5, 2009, pp. 1209-1223.
- [10] S. Shulman and M. Scharf, "Adolescent Romantic Behaviours and Perceptions: Age- and Gender-Related Differences and Links with Family and Peer Relationships," *Journal of Research on Adolescence*, Vol. 10, No. 1, 2000, pp. 99-118.
- [11] A. R. Lieblich, R. Tuval-Mashiach and T. Zibler, "Narrative Research: Reading, Analysis and Interpretation," *Applied Social Research Methods*, Sage Publications, Thousand Oaks, Vol. 47, 1998, pp. 1-200.
- [12] H. G. Prigerson, P. K. Maciejewski, C. F. Reynolds III, A. J. Bierhals, J. T. Newsom and A. Fasiczka, "The Inventory of Complicated Grief: A Scale to Measure Certain Maladaptive Symptoms of Loss," *Psychiatry Research*, Vol. 59, No. 1-2, 1995, pp. 65-79.
- [13] W. A. Collins and A. Sroufe, "Capacity for Intimate Relationships: A Developmental Construction," In: W. Furman, B. Brown and C. Feiring, Eds., *The Development of Romantic Relationships in Adolescence*, Cambridge University Press, Cambridge, 1999, pp. 125-147.
- [14] J. Connelly and A. Goldberg, "Romantic Relationships in Adolescence: The Role of Friends and Peers in their Emergence and Development," In: W. Furman, B. Brown and C. Feiring, Eds., *The Development of Romantic Relationships in Adolescence*, Cambridge University Press, Cambridge, 1999, pp. 266-290.
- [15] S. Sprecher, "Two Sides to the Breakup of Dating Relationships," *Personal Relationships*, Vol. 1, No. 3, 1994, pp. 199-222.
- [16] C. Perilloux and D. M. Buss, "Breaking up Romantic Relationships: Costs Experienced and Coping Strategies Deployed," *Evolutionary Psychology*, Vol. 6, No. 1, 2008, pp. 164-181.
- [17] K. D. Rudolph and C. S. Conley, "The Socioemotional Costs and Benefits of Social-Evaluative Concerns: Do Girls Care Too Much," *Journal of Personality*, Vol. 73, No. 1, 2005, pp. 115-138.
- [18] K. D. Rudolph, "Gender Differences in Emotional Responses to Interpersonal Stress during Adolescence," *Journal of Adolescent Health*, Vol. 30, No. S4, 2002, pp. 3-13.
- [19] S. Nolen-Hoeksema and J. S. Girgus, "The Emergence of Gender Differences in Depression during Adolescence," *Psychological Bulletin*, Vol. 115, No. 3, 1994, pp. 424-443.
- [20] S. Nolen-Hoeksema, C. Grayson and J. Larson, "Explaining the Gender Differences in Depressive Symptoms," *Journal of Personality and Social Psychology*, Vol. 77, No. 5, 1999, pp. 1061-1072.
- [21] S. Herbert and N. Popadiuk, "University Students' Experiences of Nonmarital Breakups: A Grounded Theory," *Journal of College Student Development*, Vol. 49, No. 1, 2008, pp. 1-14.

# Communicating (and Responding to) Sexual Health Status: Reasons for STD (Non) Disclosure

Tara M. Emmers-Sommer<sup>1</sup>, Kathleen M. Warber<sup>2</sup>, Stacey Passalacqua<sup>3</sup>, Angela Luciano<sup>3</sup>

<sup>1</sup>Department of Communication Studies, University of Nevada, Las Vegas, USA; <sup>2</sup>Wittenberg University, Springfield, USA; <sup>3</sup>Department of Communication, University of Arizona, Tucson, USA.

Email: tara.emmersommer@unlv.edu

Received May 18<sup>th</sup>, 2010; revised July 3<sup>rd</sup>, 2010; accepted July 6<sup>th</sup>, 2010.

## ABSTRACT

*This investigation examines the sexual health status of individuals and their attitudes toward STDs and STD disclosure (and reasons for nondisclosure) and response. In doing so, this study provides insight into young adults' sexual practices, attitudes, and behaviors. Two-hundred fifty-three adults of varying relational status participated in an online study about sexual health status, sexual health knowledge, sexual behaviors, relational factors, responses to STD disclosure, reasons for nondisclosure, and if circumstances under which a STD was acquired affected partners' reaction to the disclosure. Results indicated that, although undergraduate students are knowledgeable about safer sex practices and are concerned about STDs and birth control, few "always" practice safer sex. When considering relational status, STD status and disclosure of that status becomes complicated. However, findings of this investigation suggest that potential positive responses to a perceived negative disclosure (i.e., a positive STD status) are possible when certain relational factors exist and the circumstances surrounding the acquisition of the STD involve more external (e.g., didn't know prior partner had STD) versus internal locus (e.g., partner engaged in risk behavior) of control factors.*

**Keywords:** STDs, Self-Disclosure, Sexual Health, Condom Use, Safer Sex

## 1. Introduction

Much research exists on HIV and AIDS [1]. Similarly, much research exists on actual versus perceived knowledge about STDs [2]. Within the extant communication literature, little research exists regarding individuals communicating reasons for (not) disclosing a positive STD status and the reception of such a disclosure. Clearly, communicating about one's sexual health status and feeling comfortable doing so are of value as such communication adds to our repertoire of knowledge about safer sex, safer sexual communication as well as the safety of the self and others.

According to Emmers-Sommer and Allen [1], "safer sex is "any action a person takes to diminish the level of risk for HIV infection". This definition can also be applied to reducing the risk of STD infection. Safer sex is most often used to describe condom use during sexual behavior to prevent contact with bodily fluids. Other sexual behaviors exist that are deemed "safer" than others. For example, engagement in mutual masturbation vs. anal sex or engagement in oral sex (which does carry

some degree of risk) vs. engagement in vaginal sex are both considered to be safer sex practices. One can also reduce his or her STD or HIV risk by reducing the number of sexual partners and engaging in sexual behavior with partners who don't carry increased risk factors (e.g., IV drug use, multiple partners, prostitution). Understanding a partner's risk factors, however, necessitates that individuals engage in candid discussions with the partner as well as be open and honest about their own sexual health.

### 1.1 Barriers to Disclosure of Sexual Health Status

Unfortunately, many individuals perceive candid sexual discussions as inappropriate and telling or asking about such information as "nobody's business". Engagement in such discussions is deemed taboo by many and as an expectancy violation. Asking about another's sexual practices and health might be deemed offensive. Similarly, engagement in such disclosures about the self might arouse suspicions in a potential partner. According to Lucchetti [3], deceptive disclosure practices about

sexual history or sexual health status is not uncommon due to the fear that disclosure of information would reduce the likelihood of sex with a partner. According to the author, 1/5 of respondents report misrepresenting their personal sexual history to partners. Disclosing one's own sexual history or being willing to openly hear that of a partner requires a variety of personal attributes, such as courage, willingness to have an open mind, and willingness to be nonjudgmental, among others. Indeed, for some, sexual history disclosure can cause embarrassment or threaten the relationship [4].

## 1.2 Sexual Script Theory

Sexual script theory [4-7] examines how individuals' scripts for sexual attitudes and behavior are acquired, shaped, reshaped, renegotiated, and enacted in relationships. Sexual scripts are influenced at cultural, interpersonal, and intrapsychic levels [5-7].

## 1.3 Cultural Scripts

Strongly influenced by the media, cultural scripts are the broadest of the three levels of sexual scripts and constitute overall schemas of sexual behavior at the social level [4]. Cultural scripts involve ascertaining which partner is appropriate to desire and pursue sexually, which type of relationship between the sexual partners is appropriate, when/where partners should engage in sexual activity, and how partners are supposed to feel in relation to the engagement in the sexual activity. These schemas contribute to how individuals are supposed to behave and make sense of their experiences [5-7].

## 1.4 Intrapsychic Scripts

Intrapsychic scripts constitute "individual desires, motives, and actions that create and sustain sexual arousal" [4]. Hynie, Lydon, Cote and Wiener [8] contended that the internalization of intrapsychic scripts affects how interpersonal scripts are carried out. Intrapsychic scripts reflect a person's desires and his/her expectations about social interaction.

## 1.5 Interpersonal Scripts

Individuals' experiences and sexual and relational histories affect their interpersonal scripts [8]. Interpersonal scripts are created by an individual's interpretation of the cultural script and their internalization of their intrapsychic script [4]. Hynie *et al.* [8] contended, "In other words, rehearsal of interpersonal scripts derived from cultural scenarios actually shapes individual attitudes, values and beliefs and, in this manner, interpersonal scripts act as the link between individual attitudes and societal norms". Sexual scripts involve the need to create routine and recognizable patterns of behavior so parties involved in a sexual act know what actions are expected

or required. Sexual practices become episodes that are negotiated between or among individuals. Each participant needs to recognize his or her role in the script as well as others' roles. Actions that fall outside of the script can be construed as expectancy violations [1]. This contention is important as it relates to sexual behavior and disclosure of sexual attitudes, sexual history, and sexual health status. Specifically, many individuals would consider asking someone about risk behaviors to be non-normative and outside of an appropriate script. Thus, individuals experience anxiety and pressure to engage in normative scripted communication behaviors and sexual behaviors, even if doing so constitutes a relational or health risk for the individual and partner. This anxiety and fear of being viewed negatively or as deviant is further compounded by the individual's personal knowledge of having a STD and disclosing it to a partner or potential partner. As noted earlier, the anxiety felt over anticipated negative reaction and rejection could lead some individuals to engage in deception about their sexual health status [4]. This aforementioned review leads to the following research questions:

RQ1: What is the sexual health status profile of participants?

RQ2a: How concerned are participants about HIV, STDs, and pregnancy?

RQ2b: What sexual health issue is most concerning to participants?

RQ3: How knowledgeable are participants about birth control and condom use?

RQ4: What are participants' attitudes about condom use?

RQ5: When is the appropriate time (e.g., upon first meeting, before first having sex) to disclose one's having a STD?

RQ6: What reasons do participants provide for why an individual who knowingly has a STD to not disclose it to a partner?

RQ7: How do participants respond to a partner's STD disclosure?

RQ8: Does how a participant's partner contracted a STD affect reaction to the disclosure?

## 2. Method

### 2.1 Instruments

Some of the informational questions used in this study were derived from the Henry J. Kaiser Family Foundation's National Survey of Adolescents and Young Adults: Sexual Health Knowledge, Attitudes and Experiences [9]. Several additional questions were added by the authors as well as the implementation of the condom use self-efficacy scale [10]. Reliability and descriptive information regarding this scale is reviewed below.

*Condom-use Self-efficacy Scale.* Undergraduate stu-

dents' condom self-efficacy was measured using Brafford and Beck's [10] Condom-use Self-efficacy Scale. Items for this scale were originally gleaned from three sources: an expert panel, previous literature, and input from students themselves. From these sources, 15 factors were identified as they related to college students' self-efficacy with condom use. The authors then created 28 self-efficacy items to cover the breadth and depth of the 15 factors. Each item is measured on a 1-5 scale (1 = strongly disagree, 5 = strongly agree), with several reverse-scored items. Brafford and Beck [10] reported a 0.91 (Cronbach's  $\alpha$ ) for the measure. With the present sample, reliability was an acceptable 0.91 (Cronbach's  $\alpha$ ).

## 2.2 Procedures

Individuals who participated in this study completed an online survey. All participants for this study were enrolled in various undergraduate communication courses at a large, southwestern university. The authors believed it appropriate to target undergraduate students as the population of interest given the degree of sexual activity and number of sexual partners among this population. Solicitation for students occurred in a number of fashions. First, certain classes were assigned to the researchers for participant solicitation. If the course instructor had a course webpage, then the link to the online survey was posted on the course webpage. Because the webpage was password protected, only students enrolled in those courses—and who wished to participate in the study—could access the survey link. In the event a course did not have a webpage, the researchers visited the class and wrote the online survey link on the blackboard for students who wished to participate. Individuals who participated in the study read an online disclaimer, explaining the nature of the study, and agreed to the terms of the study, including that they were at least 18 years of age and realized that they would be asked questions that were relational and sexual in nature. Given the survey was conducted online, participants completed the survey confidentially. No names were taken at any time. Upon completing the survey, participants clicked a "submit" button which submitted their survey responses to a CGI bin. Participants received a receipt to print and submitted the receipt to their respective instructor to receive extra credit.

## 2.3 Sample

Two-hundred fifty three ( $n = 253$ ) individuals partici-

pated in this study, of which 152 reported being women, 64 reported being men, and 37 did not report their sex. Of the 253 participants, 166 reported currently being in a relationship. Of the male participants currently in a relationship, 96% reported that they were in a heterosexual relationship. Of the female participants currently in a relationship, 95.5% reported that they were in a heterosexual relationship. Regarding relationship status, 54 individuals reported that they were casually dating, 100 reported that they were seriously dating, 3 reported that they were engaged, 9 reported that they were married, 51 reported that they were not currently in a relationship, and 36 did not answer the question. Of those currently involved in a relationship, the average relationship length was 15.64 months, with relationship length ranging from less than one month to 13 years. Of those currently involved in a relationship, 84.8% reported that they were sexually active within their relationship. Of those individuals who were sexually active, 74.8% reported that their relationship was monogamous, 17% reported that it was non-monogamous, and 8.2% reported that they didn't know if their relationship was monogamous or not. Similarly, 75.9% of the participants reported practicing safer sex (e.g., condom use) whereas 24.1% reported that they did not practice safer sex. Interestingly, however, follow-up questions on specific sexual acts and condom use indicated a bleaker picture of safer sexual practices. Specifically, participants were asked to rate their condom usage on a scale of 1 = never to 5 = always in regard to various sexual acts. Results are indicated in **Table 1**.

RQ1 asked, "What is the sexual health status profile of participants?" Of all participants in the sample, 47.9% reported having been tested for HIV and other STDs and 52.1% reported not having been tested. Participants who did get tested were asked to report why they had been tested. Three reported doing so because they were experiencing symptoms, 72 reported doing so just for their own information—to be "on the safe side," three reported getting tested because a former partner had informed them of tested positive for a STD, 41 reported being tested at the suggestion of their physician, 9 reported being influenced by the media to get tested, and 7 reported being influenced by friends to get tested. Other reasons reported for getting tested included experience with prostitutes, military requirement, to be put on birth control, being sexually active in the past, and as a basis for employment (each incidence reported once). Partici-

**Table 1. Undergraduate students' reporting of safer sexual practice by sexual act**

	Never	Rarely	Sometimes	Almost Always	Always
If I have vaginal sex, I use a condom	9.8%	11.1%	20.9%	27.8%	30.3%
If I have oral sex, I use a condom (to perform oral sex on a man) or a dental dam to perform oral sex on a woman)	83.5%	5.1%	5.1%	3.0%	3.4%
If I have anal sex, I use a condom	31.1%	3.8%	11.8%	10.8%	42.5%

pants were asked if they had ever had an STD and 7.8% reported “yes,” 81.6% reported “no,” and 10.6% reported “don’t know”. Two participants reported having herpes, 2 reported having gonorrhea, 4 reported having chlamydia, 9 reported HPV, and one reported having HPV-genital warts. Participants were asked if their current relational partner had an STD. Of those participants currently in a relationship, 3% reported that their partner had an STD, 83.4% reported that their partner did not have an STD, 12.8% reported that they didn’t know if their partner had an STD or not, 4 reported that it was a “non-issue,” and 2 did not answer the question. All participants were asked to report if any past partner, to their knowledge, had an STD. Of those answering the question, 5.6% reported “yes,” 73.5% reported “no,” 20.9% reported that they “didn’t know” and 38 participants didn’t answer the question.

RQ2a and b asked, “How concerned are participants about HIV, STDs, and pregnancy” and “What sexual health issue is most concerning to participants?” For those answering the questions, 75.9% reported that HIV, STDs, and pregnancy were “A very big concern,” 15.3% reported that it was “A somewhat big concern,” 6.9% reported that it was “Not much of a concern,” 1.4% reported that it was “Not a concern at all,” and 0.5% reported “Don’t know”. Participants most often reported that HIV was most concerning to them (48.6%), followed by pregnancy (34.4%), and 17% reported that they were most concerned by STDs (gonorrhea, syphilis, genital warts, chlamydia, herpes).

RQ3 asked, “How knowledgeable are participants about birth control and condom use?” Results are reported in **Table 2**.

RQ4 asked, “What are participants’ attitudes about condom use?” Results are reported in **Table 3**.

RQ5 asked, “When is the appropriate time (e.g., upon first meeting, before first having sex) to disclose one’s having a STD?” Results are reported in **Table 4**.

For RQs 6-8, a coder coded all of the responses. Using procedures similar to Emmers and Canary [11], responses were placed into categories derived by theme. When a response did not fit a category, a new category was formed. A second coder served as a reliability check

for a random 20% of the responses for each question. Reliability for RQ6-RQ8 were 0.88, 0.96, and 0.96 (Cohen’s *kappa*), respectively.

RQ6 asked, “What reasons do participants provide for why an individual who knowingly has a STD to not disclose it to a partner? Results are reported in **Table 5**.

RQ7 asked, “How do participants respond to a partner’s STD disclosure?” Results are reported in **Table 6**.

RQ8 asked, “Does how the participant’s partner contracted a STD affect reaction to the disclosure?” Results are reported in **Table 7**.

### 3. Discussion

The purpose of this investigation was to examine sexual health status, concerns, and reasons to disclose (and not disclose) STD status and response to such disclosures. Results of this investigation indicate that undergraduate students are, indeed, concerned about STDs and HIV, have positive attitudes about condom use, and are knowledgeable about HIV and STD transmission. Nevertheless, only 30% report “always” wearing a condom during vaginal sex. And, despite the fact that HIV can be transmitted via anal or oral sex, only 3.4% report using a condom or dental dam when having oral sex and 42.5% report using a condom when having anal sex. This finding is not uncommon as many individuals, while knowledgeable about HIV, AIDS and other STDs, often do not practice safer sex. Often, individuals believe that they are not vulnerable to STD or HIV acquisition and this impression grows as the relationship does. Specifically, as relationships develop and trust increases, condoms are often abandoned for alternative forms of birth control. This finding is consistent with Metts and Fitzpatrick’s [4] contention that as relationships develop individuals seek out alternative forms of birth control.

A strong contribution of this investigation is that it examined students’ perceptions of when it was the appropriate time to disclose a positive STD status to a partner, reasons for not doing so, how one might react to the disclosure, and if the circumstances under which the STD was contracted affected reaction to the disclosure. Findings indicated that most individuals felt it was appropriate to inform the partner of a positive STD status

**Table 2. Undergraduate students’ knowledge about birth control and condom use (%)**

	Very Effective	Somewhat Effective	Not too Effective	Not at all Effective	Don’t Know
How effective are birth control pills in preventing pregnancy?	56.2%	39.6%	.9%	0%	3.2%
How effective are birth control pills at preventing HIV/AIDS?	9%	1.8%	3.7%	90.4%	3.2%
How effective are birth control pills at preventing other STDs (gonorrhea, syphilis, genital warts, chlamydia, herpes)?	.5%	2.8%	2.3%	90.4%	4.1%
How effective are condoms at preventing pregnancy?	32.1%	64.2%	.9%	1.4%	1.4%
How effective are condoms at preventing HIV/AIDS?	28.1%	47.5%	12.4%	7.8%	4.1%
How effective are condoms at preventing other STDs (gonorrhea, syphilis, genital warts, chlamydia, herpes)?	19.3%	53.2%	16.1%	6.9%	4.6%

**Table 3. Undergraduate students' attitudes about condoms (%)**

	Strongly Agree	Somewhat Agree	Somewhat Disagree	Strongly Disagree	Don't Know
It is not a big deal to have sex without a condom once in a while	4.9%	23.1%	24.7%	46.6%	8%
Unless you have a lot of sexual partners, you don't need to use condoms	2.4%	10.9%	15.8%	70.4%	.4%
Buying condoms is embarrassing	4.9%	26.9%	22.9%	40.4%	4.9%
Condoms break a lot	4.5%	31.8%	31.0%	20.0%	12.7%
It is hard to bring up the topic of condoms	2.0%	10.9%	27.9%	53.8%	5.3%
Sex without a condom isn't worth the risk	46.5%	27.3%	17.6%	6.9%	1.6%
If my partner suggested using a condom, I would feel like my partner cared about me	46.1%	34.6%	8.2%	3.7%	7.4%
If my partner suggested using a condom, I would feel relieved	45.1%	33.7%	9.3%	4.1%	7.7%
If my partner suggested using a condom, I would feel like my partner respected me	51.0%	32.2%	7.8%	2.4%	6.5%
If my partner suggested using a condom, I would feel insulted.	1.2%	4.5%	12.6%	76.4%	5.3%
If my partner suggested using a condom, I would be suspicious or worried about his/her past sexual history	1.2%	22.0%	25.2%	47.2%	4.5%
If my partner suggested using a condom, I would feel like my partner was suspicious or worried about my past sexual history	2.4%	16.3%	26.5%	48.2%	6.5%
If my partner suggested using a condom, I would be glad my partner brought it up	42.3%	42.7%	9.3%	2.4%	3.3%
If my partner suggested using a condom, I would feel like s/he is being responsible	65.0%	26.4%	4.5%	1.6%	2.4%

**Table 4. Appropriate time in a relationship to disclose a positive STD status**

	At what point in a relationship should someone reveal s/he has an STD?			Total	
	When they meet the partner	Before they first have sex	Not obligated to tell		
Relational Status					
	Casually dating	5	43	1	49
	Seriously Dating	7	91	0	98
	Engaged	0	3	0	3
	Married	4	4	0	8
	Not currently in relationship	4	45	1	50
Total		20	186	2	208

**Table 5. Reported reasons for not disclosing a positive STD status to a partner**

Reason	Example	n
Ashamed	"Too ashamed to say anything"	12
Embarrassed	"Felt too embarrassed"	110
Knowledge	"Didn't know they are infected"	5
No reason	"There is no reason to tell"	27
Other	"Wants to get to know the other first," "Might be breaking up soon"	24
Privacy	"Don't want people to know," "It is personal"	13
Rejection by partner	"Afraid of rejection," "Don't want to be loved less"	104
Selfish	"Greed," "Selfishness," "If they are a jerk and want to infect partner"	25
Transmission	"If they weren't sexually active," "they might have an STD that cannot be transmitted to another"	26

prior to first having sex. This finding is interesting because although "when we first meet" was a choice option, few chose it. This finding is consistent with what sexual script theory argues, as many perceive revealing a positive STD status to be an inappropriate disclosure early on in a relationship. Implications exist for the timing of the disclosure, as an early admittance might quash the poten-

tial for the relationship to develop. That said, waiting until the relationship has developed such that sexual, intimate contact is perceived as appropriate also holds implications. Specifically, one must now balance a negative or a potentially negative disclosure with the positive feelings felt for and by the partner. As indicated by the findings, the circumstances under which a partner con-

tracted an STD mattered to many participants. Specifically, if the STD was contracted via behaviors that are perceived as risky or irresponsible (e.g., IV drug use, prostitution, cheating), individuals were less tolerant of those infection conditions. Results indicate, however, that if the partner contracted the STD unknowingly (e.g., an infected partner in his/her past did not inform him/her) or as the result of a past, serious relationship, then individuals might accept the STD disclosure more compassionately or acceptingly. This is important information as it assists in our understanding about the potential effect of health status disclosures on partners and that certain conditions surrounding the nature of the disclosure could possibly ameliorate negative feelings.

Participants provided many reasons for why individuals might not want to disclose a positive STD status, with the two most prominent reasons being “embarrassment” and “fear of rejection”. This information is important for a variety of reasons. First, results of this investigation indicate that individuals want to know their partner’s STD status prior to having sex. Yet, the participants were also able to provide over 300 reasons why someone might not want to disclose that information. What is suggested by the findings is that if individuals felt that they could disclose their positive STD status in a safe and understanding relational environment such that the likelihood of feeling embarrassment or rejection was reduced, the likelihood of disclosure could increase. Timing of the disclosure is complicated. From a sexual script theory perspective, mentioning this type of information early in a relationship is more frowned upon than in more advanced relationships as “sex talk” is considered to be inappropriate and deviant in a relationship’s infancy. Yet, making a STD disclosure in an advanced relationship can also be perceived negatively for a variety of reasons. For one, if an individual entered into a relationship knowing s/he had a STD, his/her partner would have likely expected this information to have been part of past discussion in a close, committed relationship. Further, if a partner acquired the STD after the relationship had been established, it is again perceived as a transgression, as it suggests engagement in risk behavior (e.g., infidelity, IV drug use). Both circumstances suggest a transgression took place [12], but in different fashions.

#### 4. Implications

Numerous positive implications exist from the results of this investigation; information that holds practical implications for sexual communication skills training, sexual education programs, and counseling. Indeed, safer sexual communication skills training and sexual education are valuable and essential from a preventative standpoint. And, in a best case scenario, individuals would engage in safer sexual communication and safer sexual practices

with their partner. However, we recognize that this is often not the case for myriad reasons. For example, partners could use poor judgment, deception, or “let things get out of hand”. Even with the best of intentions, partners could be unaware of their STD status or experience condom failure (e.g., breakage, leaking). It is important to consider individuals who might be experiencing a sense of hopelessness due to mistakes, poor judgment, or lack of information. Indeed, as indicated by these results, it is not uncommon for someone with a positive STD status to feel like “damaged goods” and fear disclosing their status to a partner or potential partner out of fear of rejection or embarrassment. Valuably, this study demonstrates that a partner or potential partner might be more receptive, understanding and compassionate than an individual might have anticipated when receiving a disclosure about a positive partner STD status. As mentioned

**Table 6. Responses to a partner’s STD disclosure**

Response	n
Shocked/surprised	34
Negative emotions (angry, sad, upset)	69
Glad s/he told me/respect honesty/be supportive	26
Stop having sex	29
Get tested/see a doctor	24
Be sure to use protection	19
Break up/leave partner	32
Stay/feel the same about partner	18
Learn more/ask more questions	43
Depends on the STD/how the partner contracted it	18
Depends on how much I like the person	18
Not sure	22
Other	14

**Table 7. Circumstances in which STD was acquired and tolerability**

Circumstance	Tolerability			n
	Yes	No	Unsure	
If the partner got it from cheating		X		22
If the partner got it from gay sex		X		7
If the partner got it from promiscuous/careless behavior		X		30
If the partner was lied to/situation was not their fault	X			16
If the person got it from drugs/prostitution		X		9
If the person got from a serious relationship	X			7
How long they’ve known they had it/if they had slept with me already			X	5
Other			X	14
How s/he got it/from whom			X	16

above, this is noteworthy and informative to sexual skills training, sexual education programs, and counseling contexts in which sexual issues are a point of contention. What the findings of this investigation suggest is that individuals are willing to have the conversation and, under certain conditions, are more willing to be understanding, compassionate and accepting of the situation. Alternatively, results of this investigation also suggest that there are certain conditions under which an STD was acquired that partners are less understanding, accepting and compassionate (e.g., cheating, IV drug use, prostitution). This, too, is of value to scholars and practitioners. Indeed, this suggests a quandary for individuals who acquired an STD through these aforementioned means in the sense of to disclose or not disclose? From an ethical standpoint, one might argue that an individual should disclose their STD status to a partner or potential partner. That said, the results of this study suggest that making such a disclosure under certain acquisition conditions could damage the relationship with their partner. As such, individuals in these circumstances might feel discouraged from making such a disclosure. Knowing that, educators and practitioners can craft communication and relational skills training to focus on how individuals can most effectively communicate this information and how partners might best receive it.

## 5. Conclusions

Although the sample for this study included strong female representation, the study nevertheless is insightful and informative. To date, few studies have examined actual sexual health status of individuals and their attitudes toward STDs and STD disclosure (and reasons for nondisclosure) and response. This study provides insight into young adults' sexual practices, attitudes, and behaviors. What was found was that, although undergraduate students are knowledgeable about safer sex practices and are concerned about STDs and birth control, few "always" practice safer sex. Findings of this investigation suggest that potential positive responses to a perceived negative disclosure (*i.e.*, a positive STD status) are possible when certain relational factors exist and the circumstances surrounding the acquisition of the STD involve more external (e.g., didn't know prior partner had STD) versus internal locus (e.g., partner engaged in risk behavior) of control factors.

## REFERENCES

- [1] T. M. Emmers-Sommer and M. Allen, "Safer Sex in Personal Relationships: The Role of Sexual Scripts in HIV Infection and Prevention," Lawrence Erlbaum Associates, Hillsdale, 2005.
- [2] D. Rouner and R. Lindsey, "Female Adolescent Communication about Sexually Transmitted Diseases," *Health Communication*, Vol. 19, No. 1, 2006, pp. 29-38.
- [3] A. E. Lucchetti, "Deception in Disclosing One's Sexual History: Safe Sex Avoidance or Ignorance?" *Communication Quarterly*, Vol. 47, No. 3, 1999, pp. 300-314.
- [4] S. Metts and M. A. Fitzpatrick, "Thinking about Safer Sex: The Risky Business of 'Knowing Your Partner' Advice," In: T. Edgar, M. A. Fitzpatrick and V. Freimuth, Ed., *AIDS: A Communication Perspective*, Lawrence Erlbaum Associates, Hillsdale, 1992, pp. 1-19.
- [5] W. Simon and J. H. Gagnon, "Sexual Scripts," *Society*, Vol. 22, 1984, pp. 52-60.
- [6] W. Simon and J. H. Gagnon, "Sexual Scripts: Permanence and Change," *Archives of Sexual Behavior*, Vol. 15, No. 2, 1986, pp. 97-120.
- [7] W. Simon and J. H. Gagnon, "A Sexual Scripts Approach," In: J. H. Greer and W. T. O'Donohue, Ed., *Theories of Human Sexuality*, Plenum Publishing, New York, 1987, pp. 363-383.
- [8] M. Hynie, J. E. Lydon, S. Cote and S. Wiener, "Relational Sexual Scripts and Women's Condom Use: The Importance of Internalized Norms," *Journal of Sex Research*, Vol. 35, No. 4, 1998, pp. 370-380.
- [9] H. J. Kaiser, T. Hoff, L. Greene and J. Davis, "National Survey of Adolescents and Young Adults: Sexual Health Knowledge, Attitudes, and Experiences," 2003. <http://www.kff.org/youthhivstds/upload/ational-Survey-of-Adolescents-and-Young-Adults.pdf>
- [10] L. J. Brafford and K. H. Beck, "Development and Validation of a Condom Self-Efficacy Scale for College Students," *Journal of American College Health*, Vol. 39, No. 5, 1991, pp. 219-225.
- [11] T. M. Emmers and D. J. Canary, "The Effect of Uncertainty Reducing Strategies on Young Couples' Relational Repair and Intimacy," *Communication Quarterly*, Vol. 44, No. 2, 1996, pp. 166-182.
- [12] S. Metts, "Relational Transgressions," In: W. R. Cupach and B. H. Spitzberg, Eds., *The Dark Side of Close Relationships*, Lawrence Erlbaum Associates, Mahwah, 1994, pp. 217-239.

# Mapping the Self with Units of Culture

Lloyd H. Robertson

Northlands College, La Ronge, Canada.  
Email: [Lloyd@hawkeyeassociates.ca](mailto:Lloyd@hawkeyeassociates.ca)

Received May 10<sup>th</sup>, 2010; revised June 9<sup>th</sup>, 2010; accepted June 11<sup>th</sup>, 2010.

## ABSTRACT

*This study explored a method of representing the self graphically using elemental units of culture called memes. A diverse sample of eleven volunteers participated in the co-construction of individual “self-maps” during a series of interviews over a nine month period. Two of the resultant maps are presented as exemplars. Commonalities found in all eleven maps lend support to the notion that there are certain structures to the self that are cross-cultural. The use of memes in mapping those structures was considered useful but insufficient because emotive elements to the self emerged from the research that could not be represented in memetic form. Suggestions are made for future research.*

**Keywords:** Culture, Identity, Memes, Self, Self-Structure

## 1. Introduction

Psychologists have discussed many aspects of the self including self-concept [1,2], self-esteem [3,4], self-actualization [5,6], self-efficacy [7,8], and self-validation [9]. Eric Erikson said, “The ability to form intimate relationships depends largely on having a clear sense of self” [10]. William Bridges [11,12] tied his theory of adult transition to changes in this “self”. Alfred Adler placed the self at the core of “world view” [1], and Adlerians continue to emphasize social interest, intimacy and production in planning for self-change [13,14]. Despite its central importance to psychology, little has been done to empirically detail and map the core concept of self. Rom Harre [15] despaired at the difficulties inherent in such a study:

“The self that manages and monitors its own actions and thoughts is never disclosed as such to the person whose Self (sic) it is. It is protected from even the possibility of being studied empirically by its very nature. Whenever it tries to catch a glimpse of itself it must become invisible to itself, since it is that very self which would have to catch that very glimpse. It is known only through reason. It is never presented in experience.”

William James [16] postulated the existence of an objective “me” that included physical, active, social and psychological components coupled with a subjective “I” that included qualities of volition, constancy and distinctness. The Jamesian “I” and “me” were seen to be different sides of a unitary self that could at once observe and be observed, and it has become the basis of much

research into the self [17-19]. Since the Jamesian self includes that which may be seen to be me, and that which Harre had difficulty seeing, it remains an encompassing definition.

If the self is defined as a cognitive structure [20-22], then it is necessarily a cultural construct [23-25] which could be understood as consisting of units of culture [26-28]. Culture, in this sense, consists of all the ways of knowing, interpreting and doing that proliferate within a given society. Dawkins’ [29] coined the term “meme” representing elemental cultural units that exhibit attractive and repellent properties with respect to other such units. Similar terms for such units have been proposed from a variety of disciplines including “mnemotype”, “idene”, “sociogene”, “concept” and “cultorgen” [30], but the term “meme” has increasingly come to predominate and is used in this paper.

Blackmore [26] suggested that the self is an interlocking complex of memes, but she did not attempt to illustrate how this self may be structured. There has been agreement, however, that memes include cognitive and behavioral dimensions [31-33]. It would be reasonable to infer that affective and connotative meanings associated with each meme as held within the mind of the individual would be the source of Dawkins’ [29] attractive and repellent “properties,” which could then result in self-structures that may be displayed graphically.

Thus, in this exploratory study the term “meme” referred to an elemental unit of culture that exhibits referent, connotative, affective and behavioral properties. “Referent” refers to the dictionary-like idea, concept or

definition behind a culturally relevant label or term as understood by the individual. Such units of culture also had to evidence connotation and affect with the effect of prompting certain behaviors to count as memes. Relationships between memes were displayed graphically, and the resultant self-referential structures were then examined to confirm and extent our current understandings of self.

## 2. Method

Participants were recruited using print advertising and posters supplemented by presentations made to classes and community groups in a process of purposeful random sampling. Participants were volunteers who agreed to talk about themselves in depth. The age range of the eleven participants selected for this study was 24 to 59 with a median of 37.3. Eight of the participants in the sample were resident in Calgary, Alberta, Canada and three were resident in northern Saskatchewan, Canada. Four participants were university students, six were employed, and one was unemployed. The sample was equally divided by gender: five females, five males and one transsexual. With respect to nationality, eight were Canadian, one was Chinese, one was Russian, and one had joint Canadian – US American citizenship. The racial composition included seven Caucasians, two people of North American aboriginal ancestry, one Chinese, and one person whose mother was aboriginal and father was “white” who identified herself as simply “Canadian”. The eleven participants were taken to represent sufficient diversity to test the generable applicability of this method of mapping the self.

Participants were given an open-ended question inviting them to explain who they were in detail. Prompts were allowed inviting elaboration. Following the qualitative method advocated by Miles and Huberman [34], self-descriptive data obtained during these initial 1.5 to two hour interviews were transcribed, and segmented portions were given code words by the researcher representing specific units of thought. All of the segments with the same code were then grouped, and each resultant grouping or “bin” was examined for referent, connotative, affective and behavioral dimensions. Bins that exhibited all four dimensions satisfied the definition of the term “meme” as used in this study, and the qualities of each meme were examined for possible positive linkages or “attractions” with other memes. Memes that contained reference to another meme in their definition or shared one of the four dimensions were deemed to be linked. Code words representing each meme were then displayed graphically and lines were drawn represented linkages.

As an example of this segmenting process, a young aboriginal (Metis) mother of three explained how becoming pregnant changed her: “Having kids, you have no

choice but to grow up.... The first one fell in my lap, so I didn't plan the first one, he just kinda dropped in my lap; I guess you could say.” This segment was coded with the word “mother”. The resultant grouping of all segments coded for “mother” exhibited the following characteristics:

REFERENT: A biological fact associated with bearing children

CONNOTATION: There is a maternal responsibility to those children to shape their behavior, and to ensure their safety and success

AFFECT: Love, caring, valuing of children

BEHAVIOR: Ensures that her children are safe, cared for, read to, go to school, and are given toys

This woman's belief that she was responsible for her children's safety led to anxiety that they might not be safe. Her behaviours included sleeping with her baby, waking up in regular intervals to check the baby's breathing, and forbidding her older children from playing in a grove of trees next to their yard. A meme labelled “anxious” (for anxious person) was thus linked to mother.

By identifying and linking memes, maps for each participant were constructed. Themes involving clusters of memes were noted on each map. Self-maps were then returned to individual participants for elaboration, correction and confirmation. In each case a more elaborate second map was prepared based upon what each participant said in their second interview. These maps were then returned to the participants in a third interview. Only two participants suggested additions to their maps at the third interview. Self-maps were tested for resonance during the second and third interviews with resonance defined as a felt experience of self-identification with the maps as presented. Each participant had the final say on the composition of their self-map.

## 3. Individual Results: The Maps of Two Selves

Due to space limitations it was not possible to present all participant self-maps. Two were selected for presentation on the basis of diversity with one representing a male from an individualist culture and the other representing a female from a collectivist culture. The subsequent section includes a summary comparison of all eleven self-maps.

### 3.1 The Self of an Urban Caucasian Canadian Male

“Brent” explained who he was in a series of remembered narratives; moreover, he defined himself as one who remembers. More segments (13) were coded for “rememberer” than any of the other 30 memes applied 119 times to 74 segments of text transcribed from the initial interview. By linking related units of culture, and by adding

thematic interpretive understandings, the complex structure of interlocking memes illustrated in Figure 1 emerged with “rememberer” pictured as a diamond so as to highlight its importance as a theme in his life. Links were drawn connecting it with “reflective”, “animator”, “student”, “storyteller” and “self-changer” memes, and a thematic arrowed line was drawn to other aspects of himself on which he reflected including: “self-aware”, “friend”, “caring”, “family member” and “packrat”.

The numbers beside the name of each meme in **Figure 1** refer to the number of segments coded for that meme during the initial interview. Memes without numbers were added during subsequent interviews. Memes linked to adjoining memes shared some connotative, affective or behavioral quality. For example, “self aware” is linked to “storyteller” because it is through the process of telling stories Brent became more self-aware. In addition to linked memes, themes were generated that linked larger portions of the self-map. Such themes included “humorous/takes self lightly”, “empowered animator” and “good person”. Themes emerged from the data and are represented in rectangle form. Broad arrows were drawn from these themes to related memes. For example, Brent displayed his empowerment through his work as a broadcaster and his capacity for self-change; therefore, an arrow was drawn connecting these to memes with “empowerment”. Similarly, the theme of taking himself lightly was woven, behaviourally with self-deprecating humour, into his roles as a student, teacher, friend, leader and broadcaster.

Brent defined himself as both “rigid” and “flexible”. Tension between these two memes is displayed with a double headed arrow connecting the two. Similarly, memes for “Catholic” and “environmentalist” were also defined by Brent as in conflict. After reviewing his initial map, Brent suggested that he consisted of three “selves:” “self characteristics” consisting of relatively stable physical and psychological features, a feeling or emotional self, and a self defined through activity. He said that at any given moment, all of these “selves” would likely be operative and that his feelings and emotions would trigger other aspects of himself.

A map is necessarily a static representation, but the self as experienced by Brent was a changing entity. For example, Brent recounted his attempt to understand the action of a former girlfriend who had ended their relationship after she saw his house. He resolved to deal with some aspects of his “packrat” behaviours that she found off-putting. He saw this as evidence of a new “flexible” self, and this flexibility was subsequently applied to how he judged others.

The meme labelled “self-esteem” represents a belief in the value of working on this aspect of the self through positive self-affirmations, recorded and reviewed positive memories and positive thinking. Brent explained that

he had not developed the level of self-esteem he needed to pursue his career until he was well into adulthood, and he attributed his new emphasis on self-esteem to the sustained intervention of a significant other who provided him with evidence of previously unrecognized capabilities.

Brent identified the theme “good person” during our second interview while reflecting on an initial version of his self-map. He said his motivation to understand others flowed from a desire to continue to see himself as a good person, and this was reflected in his “activist”, “environmentalist”, “positive spirit”, “empathetic”, “friend”, “caring” and “kind” memes.

Brent also added “Catholic”, “rigid”, “radio listener” and “music” to his self-map at this interview. Although he was born Catholic, he did not consider himself devout, but he needed a letter from a priest so that he could obtain a position as a teacher. He traced his tendency to being rigid and uncompromising to his family of origin which he described as “very oppressive”. Hence, a link was drawn between “rigid” and “family member”.

Brent’s third interview resulted in the addition of just one additional meme to his self-map, “frugal”. He said his frugality came from his parents who were “too concerned with saving.” Brent saw himself as frugal with both time and money. He said that for 7 years he did not have a television, and he felt good about this decision, but the internet had now replaced the potential television had for unprofitably occupying his time. Signs of Brent’s frugality had (after the initial interview) been interpreted as a function of his environmental concern for the planet, but this new information suggested that his frugality with respect to the purchase of possessions and the expenditure of his time constituted an ethic related to his upbringing. Although compatible with environmental activism, such frugality could exist independently. Thus, a meme for frugal was added to a third version of Brent’s self-map linked to both “family” and “environmentalism”.

### 3.2 A Woman from the Interior of China

“Maomao” was a single woman in her twenties who, at the beginning of this study, was a student at a Canadian university. She responded to the invitation to tell the researcher about herself by talking about the city in which she was born and raised. She said she was from the middle city of the middle province of China. She mentioned with apparent pride that this city had been the capital of ancient China on thirteen separate occasions, and she described several local historic and cultural attractions. She also talked about her parents, her extended family and each of their occupations. She went into some detail about her elementary, middle years and university education. She talked about her university thesis involving the application of computer graphics to Chinese calligraphy.

This led to a discussion of her grandfather who was a famous Chinese calligrapher. She talked about the teachings her grandfather gave her, and she described several techniques of doing Chinese calligraphy. She talked about developing an algorithm sufficient for two-layered brush strokes on Chinese grass paper. She voiced the hope her parents would be able to come from China to attend her convocation.

Maomao's initial statement is summarized in some detail because it presents what she felt a person, not of her culture, should know to better understand her. She

felt it was important for the interviewer to know something about her city of origin. She both identified with and had pride in that city, and this is represented in her self-map as "territorial" representing, not possessiveness, but identification. "Territorial" was interwoven repeatedly with family. Seventeen out of 82 segments were coded for "Family person," and this coding was linked to "territorial" in Figure 2 as a theme as well as a meme.

More segments (19) were coded for "deference" than "family member," although the two were linked. The label, "deference," stands for a self-definition as a defer-

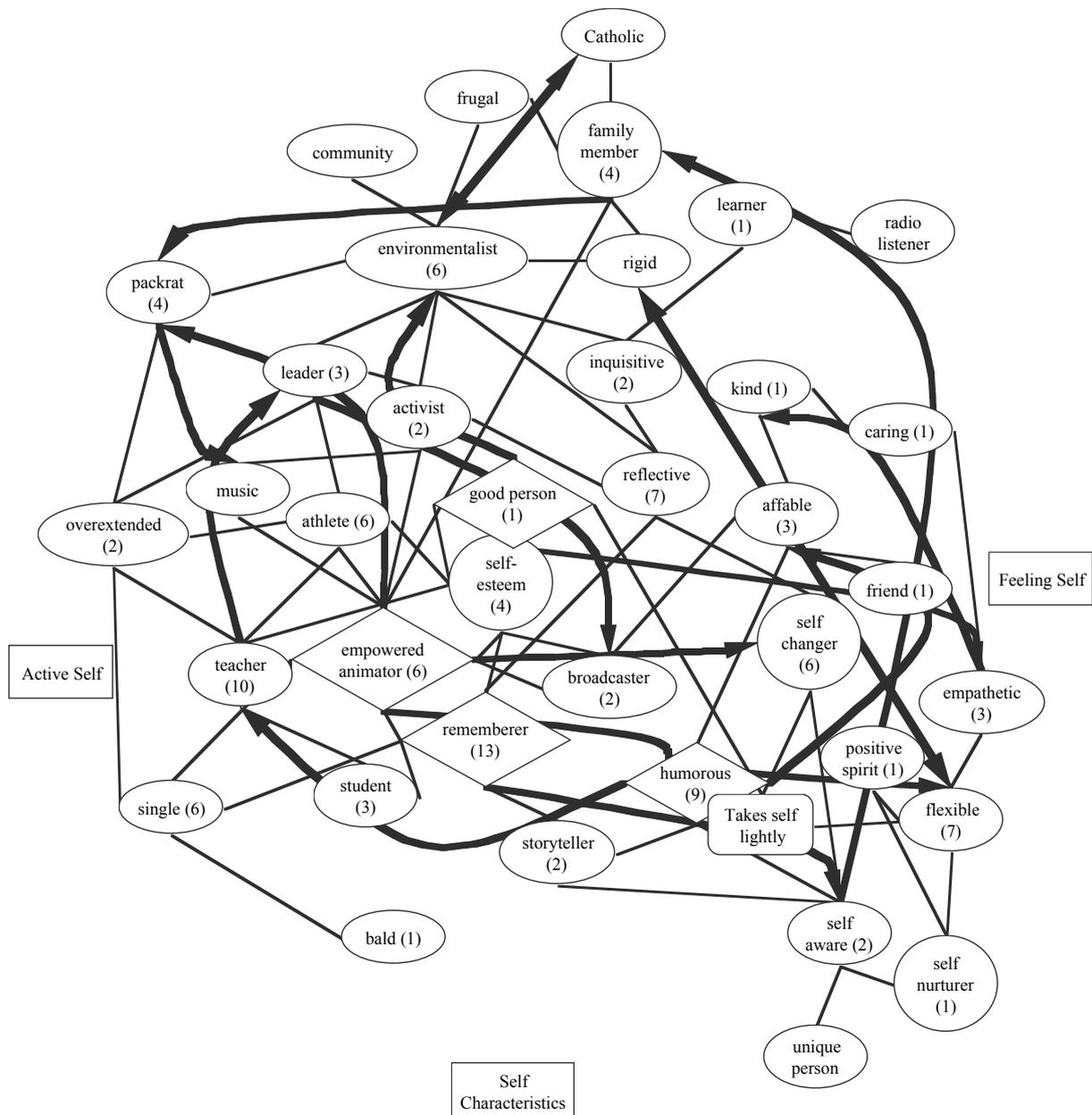
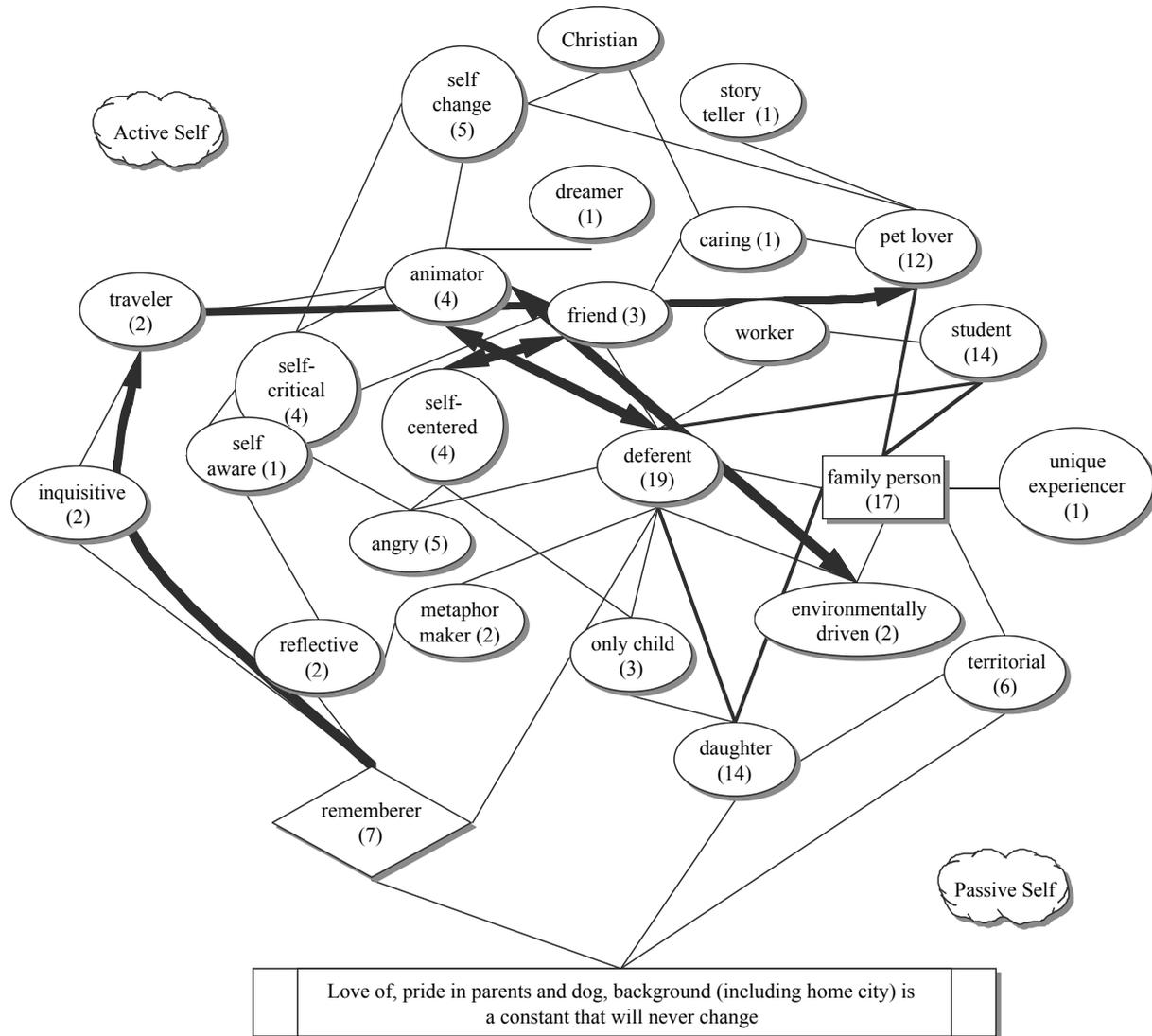


Figure 1. Memetic map of Brent resulting from the segmentation and coding of his initial interview with changes that resulted from subsequent interviews



**Figure 2. Memetic map of Maomao resulting from the segmentation and coding of her initial interview with revisions from subsequent interviews**

ent person, someone who submits to the decisions of significant others. Maomao said even small decisions, such as what to wear, were made by her parents prior to her leaving home. She did not like the subject they chose for her to study at university, but she complied. Maomao panicked during her first two days in Canada because she had no ready access to her parents, but with the help of her landlord she obtained a cell phone and a computer, and the parental contact was re-established. She reported, “I still cannot make decision, so found like before, I want to listen to the command.” When the decision of a significant other differs from her wishes, she feels sadness, but when peers enforce a decision she does not like, she feels anger.

Paradoxically, Maomao reported an ability to make independent decisions. As an undergraduate student in

Beijing she bought a dog. Added significance accrued to Maomao’s first recalled independent act because her father was not fond of dogs. None-the-less, she was able to convince her parents to accept the dog when she returned from Beijing, and when she left for Canada she entrusted them with the dog’s care. Maomao displayed a tendency to be self-critical by blaming herself for the death of her dog even though she was not in the country at the time. She also derided herself for her difficulty in making decisions, for displaying anger, and for being impatient.

Maomao displayed volition by devising a plan to go back to her old university in China before letting her parents know that she was returning. With this ruse, her parents would not have an opportunity to insist that she spend all her time in her home city. She explained, “The thing is, I cannot ask my parents exactly what I want

because they would not allow me to do something, and I am old enough, I think.”

Maomao’s account suggested potential conflict between her “animator” and “deferent” memes. This tension was pictured in **Figure 2** by a double-headed arrow representing repulsion. A similar tension line is pictured between “friend” and “self-centered,” and between “self change” and “environmentally driven.” These lines of tension display a conflict between her passive and active selves.

On reviewing the self-map created from her first interview, Maomao said her passive self was far more prominent than her active self, and she referred to herself as a “robot”. She suggested that the meme “environmentally driven” should be represented centrally in her map. The animator meme remained imbedded in Maomao’s self-definition as she reported a capacity to act independently under certain circumstances, and she resented her desire for direction. The possibility that such resentment was a cross-cultural effect was explored, but she said she also had this robot-like feeling before coming to Canada.

By the second interview, Maomao was working and had her own apartment. She had complained, during the first interview, that the Canadian family with which she had stayed drank alcohol too much, but she had made some “church friends” who did not drink. Maomao said she now considered herself to be a Christian. The “church people” taught her to pray, and she said she found prayer to be helpful when stressed. As a result of this information, a new meme for “Christian” was added to her map linked to “self-changer” and “caring”.

Maomao reviewed her revised memetic self-map approximately two months after her second interview. She said she felt comfortable in a passive role, but she can, with effort, be self-activated. Although she realized that she can make decisions on her own, she said she prefers not to do so. Being deferent allows her to do other things because she does not have to take the time to gather all the information she needs to make good decisions.

#### 4. Collective Results

Self-maps for each of the eleven participants were prepared and refined using the method described. Seven participants said the maps reflected who they were at a feeling level on the second interview. This point of resonance was reported by ten participants by the third interview.

All eleven self-maps included elements of volition, constancy, distinctness, and feeling. In addition, two aspects of the Jamesian objective self, “active” and “psychological” were found in the maps of all of the participants. All participants agreed that their self changed over time, and all related self-change to transitional events. Three of the participants said they undertook planned

self-transitions during the course of this study.

All of the participants voiced narratives as to how they overcame adversity in becoming who they were. They also recalled initiating developmental changes to themselves. For example, eight reported changing their religious beliefs motivated by a desire to become better people in some ways. Six of these rejected Christianity with three becoming atheists, two embracing Aboriginal Spirituality and one becoming a theist without attachment to a recognized religion. One participant (Maomao) was raised as an atheist but subsequently became Christian. The remaining individual (Brent) rejected Catholicism, but then made a personal accommodation with it related to obtaining employment. The remaining three participants who did not change religious belief told stories of how they had initiated change to become better parents and/or spouses.

Despite a propensity toward self-change, all participants reported a feeling that they were the same person over time, although two noted that this feeling of constancy could be illusory. Every participant was able to narrate childhood experiences helping to determine who they became, and those memories contributed to the feeling of constancy. For example, one aboriginal participant explained that regardless of future changes, his memories would remind him that he is the same person who grew up in an underprivileged neighbourhood of a small Saskatchewan city. Nine other participants also presented with the act of remembering developed into either a meme or theme, and all participants engaged in the act of remembering when explaining who they were.

The Alderian [35] self-components of work, love and social interest were found in all self-maps. Every participant named aspects of themselves related to work or production, and love or intimacy. All eleven participants engaged in activities satisfying Adler’s notion of social interest, and six of these related their activities to a transcendental purpose – the need to serve a purpose or cause greater than themselves. Four of these six identified themselves as theists and two identified themselves as atheists.

The self-maps of ten participants contained memes associated with family, and six of these contained memes indicating a connection with community. Those that incorporated identification with a community in their self maps identified a formal community, as Maomao did in identifying with a Chinese Christian community. Others, such as a bi-sexual female whose friendship group included males, lesbians and other bi-sexuals, created their own informal supportive community of friends not identified as communities on their self-maps. One person failed to incorporate either family or community into her self-map, but she said that the support she had received from her local Unitarian Church was important in her acceptance of her transsexuality. Although a meme for

“Unitarian” could have been developed, this was not how she identified herself; however, as with other participants, she had found a community of people who accepted her.

All of the participants said there was some quality or qualities essential to being human, with emotions being the most often mentioned such quality. Seven participants had human feelings or emotions represented at the base of their self-maps, and one of these labelled this base “the feeling of me”. The remaining four had feelings represented in their self-maps as themes. One of these (Brent) identified a group of memes he described as his “feeling self”, but he explained that emotions permeated his entire being.

## 5. Discussion

Memes were used to illustrate relationships between culture and interconnected units of self that comprised the self-definitions of participants. Participant insistence on including recognition of emotion in their self-maps, beyond the emotive component of individual memes, was unanticipated. Thus, memes may be a necessary but insufficient component in mapping the self. It may be that a feeling of self, with its origins in the organism mapping its body states, drives the creation of an autobiographical self [36]. On the other hand, many organisms are capable of reactive feelings based on their body states without ever achieving self-consciousness. Therefore, the possibility that the self is a culturally learned construct that generates concomitant feelings additional to those generated by body states should be considered, as in the example of Brent’s “feeling self”.

If we view the self to be a theory we construct based on our personal experience, then such constructions are necessarily limited to the scope of that experience and the interpretive possibilities available to the individual. When we attempt to examine that which is doing the constructing, we are presented with a self-referencing feedback loop leading to Harre’s [15] conclusion that such a self must necessarily become invisible when it attempts self-examination. Yet, possession of a self allows one to situate one’s being in relation to others and in relation to past events and future possibilities – practices that imply a certain level of awareness. Therefore, the felt illusion of an unseen homunculus, existing momentarily outside of oneself to conduct this self-examination, is generated.

Feelings of volition, uniqueness and constancy may also be generated from the logic of having a self. It is difficult to imagine volition without an element of distinctness or individuation implying that a person, separate from others, is carrying out a particular act. None of the participants in this study were able to point an aspect of their selves that exercised this volition and attempts to name that which was unique or constant were met with responses like, “the combination (of self-characteristics)

is unique”, or “I will always be good-hearted and driven to learn”. The sense from the participants is that they had a feeling that they were volitional, unique and constant, and they sought examples from the objective record that affirmed those feelings.

Harre [37,38] said we teach children to have selves as part of the process of languaging, especially with respect to the teaching of indexical pronouns. This understanding would support a relativistic view that self-attributes like volition and uniqueness are culturally dependent. This study gave voice to the example of Maomao who was raised, culturally, to deny a volitional self. She reported that she preferred to not act volitionally, but she displayed volition in certain contexts. Her example supports the notion that feelings of volition, uniqueness and constancy are consequences of having a self, and that while cultures may attempt to repress these attributes they cannot be eliminated entirely.

The fact that each participant recalled childhood and adult transitions involving relationships with other people is not surprising if we view the self to be cultural creation [23,24,39]. Such a cultural construct would be linked to family, community and societal networks, and a self so constructed would be dependent on those encompassing networks for self-validation. We know we exist because the community surrounding us supports that existence, and our memories, encoded in cultural units provided by community and society, translate our choices and lived experience into an objectifiable record. This reinforces a sense of self-constancy that may resist beneficial change. In the example of Brent, a “poor learner” self-definition was maintained well into adulthood and changed only with extra-ordinary intervention. On the other hand, the fact that a majority of participants (8) changed their religious beliefs seems to contradict this assumption of self-constancy. This, in turn, may be a function of the Canadian multicultural context that, in effect, allows people to change their communities to reflect and support desired belief systems.

All participants reported feedback from others led to changes in themselves with six reporting that their memories served to preserve their sense of constancy amidst change. If we view the self to be a theory of who we are, then sufficient accumulative evidence will result in revisions to our self-theory. Volition allows us to examine and thus improve our selves, and is evidenced by memes showing us as animators in action. Thus, Brent defined himself as an “empowered animator”, an active doer in specific roles as a teacher, athlete, broadcaster and self-changer. On the other hand, while all participants were able to point to examples of their own volition, self-efficacy may be, in Shelly Taylor’s [40] words, “a positive self-enhancing illusion”. Maomao’s self-depiction as a programmed robot fits with this latter interpretation. Her decision to become a Christian could have

flowed from her earlier programming where both goodness and action were other-defined. Without the direct support of her family and community, she was open to finding a substitute family and community to give moral direction within the new (Canadian) context. Although she preferred to not make her own decisions, she did not consult with her parents prior to her religious conversion. It is as though her self's maintenance needs initiated an act of volition that would not be countermanded by consultation with the usual authority figures. Thus, we are presented with the paradox of an other-determined self acting independently to maintain this quality.

All of the participants to this study were able to recount childhood transitions contributing to the development of their selves. This supports the notion the self develops experientially from units of culture associated with those experiences. Evolutionary change is likely with such an entity as memes are modified, new memes compatible with existing self-defining memes are added, and old peripheral memes are discarded; however, fundamental change involving the construction of a new self would be extremely difficult. There would be no one internally to oversee such a construction as the existent self that would occupy this role is itself the object of deconstruction.

In summary, all of the participants in this study exhibited a similar structure of self. Self-change occurred in the histories of all of the participants, and they were able to detail environmental events that helped determine who they became. The initial self was established in childhood and further change to that self was evolutionary.

## 6. Limitations

People who volunteer to talk about themselves may have different characteristics than those who do not volunteer to talk about themselves. They might be expected to exhibit higher levels of assertiveness and self-confidence. Such characteristics could speak to feelings of empowerment and the volunteer's level of social activism. All the participants to this study expressed an interest in, or were engaged in, action to make the world a better place for others. It may be that there are people who do not have this orientation, and they may not be predisposed to volunteer for this kind of research. Therefore, these results cannot be interpreted as universal.

The qualities of the researcher can and do affect outcomes [41,42]. While the method used in this study attempted to minimize this risk through the use of non-directive open-ended questioning, researcher effects on the participant sample could not be negated totally. For example, one participant took two sessions before she was willing to share that she was bi-sexual. Had the researcher been more or less engaging, more or less enthusiastic, or more or less accepting of diversity, this result could have varied.

Frank [43] warned, "The risk of reducing the story to a narrative is that of losing the purpose for which people engage in storytelling, which is relationship building". In ordinary discourse, the storyteller is building a relationship with the listener; therefore, the interaction between teller and listener needs to be assessed with the understanding the story will necessarily change in some ways depending on the social objectives of the participants in the discourse. Although the relationship between client and therapist or researcher involves non-ordinary discourse which permits the reduction of a story to a narrative, people are social beings and they want to be liked, respected and acknowledged. Thus the researcher could not be a strictly neutral observer, but had an effect on participant presentation.

## 7. Recommendations for Future Research

This exploratory study demonstrated that the self may be mapped in ways that resonate with persons so mapped. Further studies are needed to determine whether the structure of the self that emerged from this study may be replicated and with which populations.

Although the self was represented from individuals from collectivist as well as individualist cultures, this research did not study specific cultures in a way that would allow us to make generalizations about cultural differences. While there may be a basic structure to the self, the importance placed on certain aspects of that structure and their relationship to other aspects of the self would be expected to vary between cultures. The method used in this research may be used in such cross-cultural comparisons. In addition, research into ethnic, class and gender difference within and between cultures could benefit from this approach.

The method outlined in this paper may also be used to inform clinical practice. None of the participants to this study were engaged in therapy at the commencement of this research. An examination of the selves of specific client populations and their comparison to the structure of the typical non-client self could potentially yield insights in epistemology and treatment.

## REFERENCES

- [1] A. Adler, "Understanding Human Nature," Fawcett, Publications, New York, 1957.
- [2] G. Vleioras and H. A. Bosma, "Predicting Change in Relational Identity Commitments: Exploration and Emotions," *Identity*, Vol. 5, No. 1, 2005, pp. 35-56.
- [3] A. Ellis, "Rational-Emotive Therapy," In: R. Corsini, Ed., *Current Psychotherapies*, Itasca Books, Minneapolis, 1979, pp. 185-229.
- [4] R. W. Lent, "Toward a Unifying Theoretical and Practical Perspective on Well-Being and Psychosocial Adjustment," *Journal of Counseling Psychology*, Vol. 51, No. 4, 2004,

- pp. 482-509.
- [5] A. H. Maslow, "Motivation and Personality," Harper and Rowe, New York, 1987.
- [6] W. L. Ventis, "The Relationships between Religion and Mental Health," *Journal of Social Issues*, Vol. 51, No. 2, 1995, pp. 33-48.
- [7] A. Bandura, C. Barbaranelli, G. V. Caprara and C. Pastorelli, "Self Efficacy Beliefs as Shapers of Children's Asperations and Career Trajectories," *Child Psychology*, Vol. 72, No. 1, 2001, pp. 187-206.
- [8] D. J. Stipek and P. S. Kowalski, "Learned Helplessness in Task-Orienting versus Performance-Orientating Testing Conditions," *Journal of Educational Psychology*, Vol. 81, No. 3, 1989, pp. 384-391.
- [9] F. I. Ishiama, "Culturally Dislocated Clients: Self-Validation Issues and Cultural Conflict Issues and Counselling Implications," *Canadian Journal of Counselling*, Vol. 29, No. 3, 1995, pp. 262-275.
- [10] M. S. Corey and G. Corey, "Becoming a Helper," Brooks/Cole Publishing, New York, 2003.
- [11] W. Bridges, "Transitions: Making Sense of Life's Changes," Addison-Wesley Publishing, Reading, 1980.
- [12] W. Bridges, "The Way of Transition: Embracing Life's Most Difficult Moments," Da Capo Press, Cambridge, 2001.
- [13] C. G. Boeree, "Personality Theories," 2006. <http://www.ship.edu/%7Ecgboree/perscontents.html>
- [14] D. C. Dinkmeyer, W. L. Pew and D. C. J. Dinkmeyer, "Adlerian Counselling and Psychotherapy," Brooks/Cole Publishing, Monterey, 1979.
- [15] R. Harre, "The Discursive Production of Selves," *Theory and Psychology*, Vol. 1, No. 1, 1991, pp. 51-63.
- [16] W. James, "The Self," In: R. F. Baumeister, Ed., *The Self in Social Psychology: Key Readings in Social Psychology*, Psychology Press, New York, 1999, pp. 69-77.
- [17] M. R. Leary and J. P. Tangney, "The Self as an Organizing Construct in the Behavioral and Social Sciences," In: M. R. Leary and J. P. Tangney, Ed., *Handbook of Self and Identity*, The Guilford Press, New York, 2003, pp. 3-14.
- [18] W. Damon and D. Hart, "Self-Understanding in Childhood and Adolescence," Cambridge University Press, Cambridge, 1988.
- [19] A. Kwiatkowska, "Sense of Personal Continuity and Distinctiveness from Others in Childhood," In: L. Oppenheimer, Ed., *The Self-Concept: European Perspectives on its Development, Aspect, and Applications*, Springer-Verlag, Berlin, 1990, pp. 63-74.
- [20] S. Greenfield, "Journey to the Centers of the Mind," W. H. Freeman & Co., New York, 1995.
- [21] R. Harre, "The Self as a Theoretical Concept," In: M. Krausz, Ed., *Relativism: Interpretation and Confrontation*, Notre Dame, 1989, pp. 389-411.
- [22] W. Mischel and C. C. Morf, "The Self as a Psycho-Social Dynamic Processing System: A Meta-Perspective on a Century of the Self in Psychology," In: M. R. Leary and J. P. Tangney, Ed., *Handbook of Self and Identity*, The Guilford Press, New York, 2003, pp. 15-43.
- [23] G. H. Mead, "The Mechanisms of Social Consciousness," In: J. Pickering and M. Skinner, Ed., *From Sentience to Symbols: Readings on Consciousness*, University of Toronto Press, Toronto, 1990, pp. 192-197.
- [24] A. Lock, "Universals in Human Conception," In: J. Pickering and M. Skinner, Eds., *From Sentience to Symbols: Readings on Consciousness*, University of Toronto Press, Toronto, 1990, pp. 218-223.
- [25] R. Harre, "Personal Being: A Theory for Individual Psychology," Harvard University Press, Cambridge, 1984.
- [26] S. Blackmore, "The Meme Machine," Oxford University Press, Oxford, 1999.
- [27] M. Donald, "A Mind so Rare: The Evolution of Human Consciousness," Norton Publishing, New York, 2001.
- [28] I. Price, "Steps toward the Memetic Self," *Journal of Memetics*, Vol. 3, No. 1, 1999, pp. 75-80.
- [29] R. Dawkins, "The Selfish Gene," Oxford University Press, Oxford, 1976.
- [30] E. O. Wilson, "Consilience: The Unity of Knowledge," Vintage Books, New York, 1999.
- [31] M. Csikszentmihalyi, "The Evolving Self: A Psychology for the Third Millennium," Harper Collins Publishers, New York, 1993.
- [32] R. Dawkins, "The Blind Watchmaker," Penguin Books, London, 1986.
- [33] L. F. Robles-Diaz-de-Leon, "A Memetic/Participatory Approach for Changing Social Behavior and Promoting Environmental Stewardship in Jalisco, Mexico," Ph.D. Dissertation, University of Maryland, College Park, 2003.
- [34] M. B. Miles and A. M. Huberman, "Qualitative Data Analysis: An Expanded Sourcebook," Sage Publications, Inc., Thousand Oaks, 1994.
- [35] A. Adler, "Superiority and Social Interest: A Collection of Later Writings," Routledge and Keagan Paul Ltd., London, 1967.
- [36] A. Damasio, "The Feeling of what Happens: Body and Emotion in the Making of Consciousness," Harcourt Publishers, New York, 1999.
- [37] R. Harre, "The Singular Self: An Introduction to the Psychology of Personhood," Sage Publications, Inc., Thousand Oaks, 1998.
- [38] R. Harre, "Language Games and Texts of Identity," In: J. Shotter and K. J. Gergen, Ed., *Texts of Identity*, Sage Publications, Inc., Thousand Oaks, 1989, pp. 20-35.
- [39] M. Leary, "The Curse of the Self," Oxford University Press, Oxford, 2004.
- [40] S. E. Taylor, "Positive Illusions: Creative Self-Deception and the Healthy Mind," Basic Books, New York, 1989.
- [41] R. Elliot, C. T. Fischer and D. L. Rennie, "Evolving Guidelines for Publication of Qualitative Research Studies in Psychology and Related Fields," *British Journal of Clinical Psychology*, Vol. 38, No. 3, 1999, pp. 215-229.
- [42] D. E. Polkinghorn, "Narrative Configuration in Qualitative Analysis," *Qualitative Studies in Education*, Vol. 8, No. 1, 1995, pp. 5-23.
- [43] A. W. Frank, "The Standpoint of Storyteller," *Qualitative Health Research*, Vol. 10, No. 3, 2000, pp. 354-356.

# Using Generalizability Theory to Evaluate the Applicability of a Serial Bayes Model in Estimating the Positive Predictive Value of Multiple Psychological or Medical Tests

Clarence D. Kreiter

Office of Consultation and Research in Medical Education, Department of Family Medicine, University of Iowa, Iowa City, USA.  
Email: [clarence-kreiter@uiowa.edu](mailto:clarence-kreiter@uiowa.edu)

Received May 10<sup>th</sup>, 2010; revised June 14<sup>th</sup>, 2010; accepted June 16<sup>th</sup>, 2010.

## ABSTRACT

**Introduction:** It is a common finding that despite high levels of specificity and sensitivity, many medical tests are not highly effective in diagnosing diseases exhibiting a low prevalence within a clinical population. What is not widely known or appreciated is how the results of retesting a patient using the same or a different medical or psychological test impacts the estimated probability that a patient has a particular disease. In the absence of a 'gold standard' special techniques are required to understand the error structure of a medical test. Generalizability can provide guidance as to whether a serial Bayes model accurately updates the positive predictive value of multiple test results. **Methods:** In order to understand how sources of error impact a test's outcome, test results should be sampled across the testing conditions that may contribute to error. A generalizability analysis of appropriately sampled test results should allow researchers to estimate the influence of each error source as a variance component. These results can then be used to determine whether, or under what conditions, the assumption of test independence can be approximately satisfied, and whether Bayes theorem accurately updates probabilities upon retesting. **Results:** Four hypothetical generalizability study outcomes are displayed as variance component patterns. Each pattern has a different practical implication related to achieving independence between test results and deriving an enhanced PPV through retesting an individual patient. **Discussion:** The techniques demonstrated in this article can play an important role in achieving an enhanced positive predictive value in medical and psychological diagnostic testing and can help ensure greater confidence in a wide range of testing contexts.

**Keywords:** Generalizability Theory, Bayes, Serial Bayes Estimation, Positive Predictive Value, Psychological Testing, Serial Medical Testing

## 1. Introduction

When a medical disease's prevalence and a medical test's specificity and sensitivity are known, an equation based on Bayes Theorem provides useful information related to the diagnostic power of a medical test. It is a common finding that despite high levels of specificity and sensitivity, many medical tests are not highly effective in diagnosing diseases with a low prevalence within a clinical population [1]. Since a large number of diseases occur only in a small proportion of the population (*i.e.* have low prevalence), the low positive predictive value (PPV) of medically diagnostic tests is of obvious concern to physicians attempting to identify the presence of a low prevalence disease. To provide an example, let's

suppose a physician is attempting to determine whether a patient has a disease that occurs in 1% of a defined patient population. When the test is performed on patients with the disease, it yields a positive test result indicating the presence of the disease in 90% of the patients (sensitivity equals .90). When the test is performed on patients without the disease, it correctly identifies 98% of those patients as disease free (specificity equals .98). An equation based on Bayes Theorem can be used to calculate the probability that a patient with a positive test result actually has the disease. The simple equation for calculating this probability is:

$$P(A|B) = P(B|A) * P(A) / P(B) \quad (1)$$

Equation (1) describes the probability that a patient

has the disease given a positive test result  $[P(A|B)]$ , and equals the probability of a positive test result given the patient has the disease  $[P(B|A) - \text{sensitivity}]$  multiplied by the probability of the disease  $[P(A) - \text{prevalence}]$  divided by the overall probability of a positive test result within the population  $[P(B)]$ . The denominator in Equation (1), the overall prior probability of a positive test result, is derived as shown in Equation (2), where  $j$  is 1, 2... and takes on as many values as there are hypotheses. In the case being discussed in this example problem, there are just two possible hypotheses ( $H_{01}$ : the patient has the disease –  $H_{02}$ : the patient does not have the disease) and hence in this example the sum is taken over just two levels. Hence, the overall probability of a positive test result is the sum of the probabilities of a positive test in those with (sensitivity) and without  $(1 - \text{specificity})$  the disease each multiplied by their prevalence in the population.

$$P(B) = [\sum_j P(B|A_j)P(A_j)] \quad (2)$$

Equation (3) displays the calculation using the levels of specificity, sensitivity and prevalence discussed in our example. Despite high levels of specificity and sensitivity, the patient with a positive test result has only a 31% chance of actually having the disease. This is a common and well known type of finding related to medical testing designed to detect low prevalence diseases.

$$P(A|B) = .90 * .01 / ((.90 * .01) + (.02 * .99)) = .31 \quad (3)$$

What is not widely known or appreciated is how the results of retesting a patient using the same or different test will impact the estimated probability that the patient has the disease. There is little guidance in the medical or psychological literature regarding whether or how the results from serial testing improve the ability to diagnosis disease when the structure or cause of the dependence between tests is uncertain. However, it is clearly important for clinicians to understand how the PPV changes when a patient is administered a second or third medical or psychological test. When the assumption of test independence applies, a serial Bayes model may provide guidance within contexts like those presented in the example just discussed.

When probabilities from a previous Bayes calculation are used to update estimates of the prior probability  $[P(A)]$ , and when independence is confirmed, we can use a Bayes serial calculation to derive the probability that a patient has the disease given a second test result. Equation (4) presents the next step in the context of our example using a Bayes serial calculation for a second consecutive positive test under the assumption that the two tests are independent. With a second positive result, the probability of having the disease goes from .31 to .95,

and our confidence in the diagnosis appears to improve dramatically. It should be noted that under the assumption of independence, parallel testing may also yield an outcome similar to serial testing. So, although the focus of this paper is on sequential or serially administered tests, when time or the occasion of the test is not an important factor in determining test independence, what is reported and discussed here may also apply to parallel testing.

$$P(A|B) = .90 * .31 / ((.90 * .31) + (.02 * .69)) = .95 \quad (4)$$

From the outcome presented in Equation (4), it appears that the PPV of tests used to detect low prevalence diseases may be dramatically improved simply by administering the test a second or third time. However as mentioned, such positive outcomes rely on an independence assumption that is critical to the valid application of the serial Bayes probability model and implies that the error rate for each test is independent. Therefore, to determine whether an enhancement of PPV can be achieved by retesting, it is necessary to first establish the primary source(s) of test error and whether, or under what conditions, each medical test can be regarded as independent.

When a “gold standard” is available for determining the accuracy of a fallible test, establishing the independence between two test administrations is straight forward. One needs simply to twice calculate the specificity and sensitivity for the second test administration, once for the group of patients who test positive on the first test and once for the group of patients who tested negative on the first test. If the two calculations are in close agreement, the assumption of independence is satisfied. Unfortunately, a “gold standard” method for checking test accuracy is often not available, and other procedures are required.

Independence between test results can be achieved when clinicians randomly sample from the test-related variables that contribute to error and when each disease positive patient is equally likely to display a false negative test result and when each disease negative patient is equally likely to display a false positive test result. Indeed, when the conditions leading to test independence are understood, the utility of testing in a low prevalence disease context can often be dramatically enhanced by a simple random replication of a testing process that samples from the variables contributing to error. To ascertain under what conditions an independence assumption is satisfied, researchers must first investigate and understand the error structure of medical or psychological test outcomes. Given the potential for dramatically enhanced diagnostic accuracy, such research is critically important in improving the utility of certain tests with low PPV.

Within many testing contexts, it is often not possible to establish the accuracy of a fallible test by comparing it

to a more accurate “gold standard” testing methodology [2,3]. Although methods for estimating disease prevalence with the use of multiple tests, none of which are gold standard, have been developed [4], and latent class analysis has been used to estimate prevalence, specificity and sensitivity in the absence of a gold standard [5-7], there is little guidance for revising diagnostic predictions for a specific patient when evaluating multiple fallible test results. When a “gold standard” test procedure is unavailable, too risky, too invasive, and/or a violation of ethical research standards, an alternate and efficient method for establishing a test’s error structure and the appropriateness of a serial Bayes-based revision of disease probability can be achieved using Generalizability (G) analysis [8]. The strength of G theory analysis is that it requires only a record of the fallible test outcomes and does not require “gold standard” testing. When outcomes for the fallible test are appropriately sampled and analyzed, precise quantification of relevant sources of error can be achieved.

Generalizability analysis is by far the most powerful method for quantifying sources of measurement error. In order to determine if, or under what conditions, a serial Bayes calculation is appropriate, a G study can analyze sampled test results and quantify and describes the error structure of a test. For example, in the context of medical testing, sources of error might be attributable to the laboratory, the clinician administering the test (e.g. psychiatric diagnosis), the occasion on which the test was administered, or some unobservable but consistent attribute of the patient. Each of these error sources can potentially lead to dependence between two tests results performed on a single patient and hence can be a source of dependent error leading to a violation of the independence assumption on which a Bayes serial testing model depends. To conduct a G study analysis, it is necessary to first collect test outcomes for randomly sampled administrations of the test. It is important to randomly sample across variables which naturally vary in the administration of a specific test and which might contribute to error in the test results. Such studies allow researchers to estimate each specified error source and establish whether, or under what conditions, a serial Bayes probability model appropriately updates patient probabilities upon retesting.

## 2. Methods

To illustrate how a G theory-based analysis might improve testing accuracy, let’s further develop our example of the hypothetical medical test. Suppose that the medical test in the example problem involves a laboratory analysis of a specimen provided by a patient. Suppose further that a team of expert medical researchers identify three variables or potential sources of error over which the

collection of test results tend to vary and which might be relevant to the outcome of the medical test in question. The first identified potential source of error concerns the occasion on which the patient is tested. Specifically, the researchers suspect that short-term fluctuations in patient values may lead to inconsistent test results. Hence, the test outcome may depend on when the patient was tested. For purposes of this illustration, we will designate this type of error as “Error Type 1”. The second hypothesized source of error (Error Type 2) relates to an unobservable and temporally stable patient attribute that causes certain patients to be consistently more or less likely to generate false positive or false negative test results. The third identified error source (Error Type 3) is related to laboratory processing. In particular, the researchers hypothesized that variation in laboratory procedure may contribute to the generation of false negative or false positive test results.

In order to understand how these sources of error influence the test’s outcome, the researchers design an experiment that samples test results from across the variables that tend to vary in the real world administration of the test within the population and that are hypothesized to contribute to error. The experiment draws a large random sample of patients from the clinical population of interest. Each patient in the sample is scheduled for multiple random appointment times at a clinic where specimens are collected. After each clinic visit, the collected specimen is divided into sub samples and sent for processing at multiple randomly selected laboratories. In G study terminology, the experiment’s object of measurement is patient ( $p$ ), and the two study variables over which sampling occurred, usually referred to as facets, are occasion ( $o$ ) and laboratory ( $l$ ). For purposes of analysis, the test’s outcomes are analyzed using analysis of variance (ANOVA) with each cell containing the result of a single test outcome (*i.e.* either positive or negative, 0/1, or a continuous variable with or without a threshold value). Equation (5) displays the G study model for the decomposition of the total observed score variance  $\sigma^2(X_{pol})$  into seven variance components that are estimated using ANOVA-based mean squares to derive estimates of the quantitative effects that compose a single test outcome ( $X_{pol}$ ).

$$\sigma^2(X_{pol}) = \sigma^2(p) + \sigma^2(o) + \sigma^2(l) + \sigma^2(po) + \sigma^2(pl) + \sigma^2(ol) + \sigma^2(pol) \quad (5)$$

The ANOVA-based research model is a fully crossed person ( $p$ )-by-occasion ( $o$ )-by-laboratory ( $l$ ) [ $p \times o \times l$ ] random model. However, unlike typical ANOVA applications which focus on F tests and follow-up significance testing of certain mean effects within the model, G studies estimate variance components (VCs) for a single outcome and quantify all sources of variance. (It should

be noted that in some medical testing applications both ANOVA-based significance testing and VC estimation might prove useful.) This G study model estimates seven VCs. There are three main effects:  $p$ ,  $o$  and  $l$ , and four interactions:  $po$ ,  $pl$ ,  $ol$ , and  $pol$ . It is useful here to consider what each VC conveys about the test results. The VCs can be verbally described as follows:

$p$  – the degree to which test results tend to yield a consistent outcome for patients across occasions and laboratories (may contain Error Type 2),

$o$  – the degree to which certain sequential occasions are more or less likely to detect a positive or negative result (contributes to Error Type 1, but in this example it should logically be zero),

$l$  – the degree to which certain laboratories are more or less likely to detect positive or negative results (contributes to Error Type 3),

$po$  – the degree to which a patient's test status tends to change depending on the occasion on which the sample was collected (contributes to Error Type 1),

$pl$  – the degree to which a patient's test status tends to change depending on the particular lab to which the specimen was sent (contributes to Error Type 3),

$ol$  – the degree to which the probability of a positive test result for a particular occasion tends to vary depending on the laboratory processing the specimen (this should logically be zero),

$pol$  – the degree to which the patient's test status depends on the occasion / laboratory combination and other un-modeled or residual sources of error (also indicates the degree to which the G study model fails to capture relevant error sources).

### 3. Results

Interpreting the magnitude of the VCs from the G study can determine whether, or under what conditions, the assumption of test independence is satisfied and whether enhanced prediction upon retesting is achieved. The total variance in the G study model [ $\sigma^2(X_{pol})$ ] is simply the sum of the all the variance components. Suppose in our example problem the test yields dichotomous data (negative/positive test results) and is summarized as the proportion of positive test results ( $\rho$ ). Therefore, model variance is estimated as approximately:  $(\rho) * (1 - \rho)$ ; and hence is equal to the proportion of positive tests observed multiplied by the proportion of negative tests obtained across all tests in the sample. Hence, the first result of interest from the experimentally sampled data in our example problem is the proportion of positive test results observed within the sample. If the random sample is of adequate size it should yield an accurate estimate of the population proportion.

If, as in our example, there are established estimates of disease prevalence, and test specificity and sensitivity the

researcher should examine the congruence between sample results and expected population values. Although a G study can productively proceed if a sample disagrees with established estimates of population prevalences and the test's specificity and sensitivity, for the purpose of simplicity in illustrating our example problem, let's assume that the proportion of positive tests obtained from our sample is in close agreement with the expected population proportion. Hence, 31% of patients testing positive in our sample reflect a patient's true positive disease status and 69% of the positive test results represent false positive results in a sample with a disease prevalence of .01. The expected proportion of positive results is .029 and the total model variance will sum to .0279.

To further illustrate, **Table 1** displays four hypothetical G study outcomes from the fully crossed G study model. Each outcome has a different practical implication related to achieving test independence. Assuming the sample is approximately consistent with expectations estimated from the population, let's focus on the VC outcomes in **Table 1**. For Outcome 1, 30% of the variance is found to be related to the patient and the largest source of the error is attributable to a patient by occasion interaction. Since the specificity, sensitivity and prevalence are known, Equation (3) suggests that in the absence of patient Error Type 2, patient variance will account for approximately 30% of the total variance in the model. Outcome 1 appears to agree closely with this expectation and hence would suggest Error Type 2 does not make a major contribution to measurement error. Further, since 60% of the variance is related to the person-by-occasion interaction ( $po$ ), test results from a specimen collected on a single occasion and submitted to multiple laboratories are unlikely to provide independent information. The obvious recommendation resulting from Outcome 1 would be that to maximize the information from retesting and to insure that results exhibit test independence, specimens should be collected on different occasions.

As another illustration, let's suppose Outcome 2 as reported in **Table 1** was the G study result of our sampling experiment. Here patient variance is significantly higher than might be expected in the absence of Error Type 2. With 60% of overall variance attributed to patient variance, this outcome dramatically exceeds what one would expect in the absence of Error Type 2. In this situation, the practical implication is that a Bayes serial calculation would always be inappropriate even if specimens were collect on multiple occasions and sent to multiple labs. This result suggests that some patients are consistently more likely to generate false positive test results.

Outcome 3 in **Table 1** displays a G study outcome where most of the error is attributable to the patient-by-

**Table 1. Percent of total variance for seven variance components for each of four hypothetical G study outcomes**

Ef- fect	VC	Outcome	Outcome	Outcome	Outcome
	Outcome 1	1 %	2 %	3 %	4 %
<i>p</i>	.0084	30	60	30	30
<i>o</i>	.0000	0	0	0	0
<i>l</i>	.0000	0	10	2	2
<i>po</i>	.0167	60	2	2	2
<i>pl</i>	.0003	1	10	50	6
<i>ol</i>	.0006	2	8	0	0
<i>pol</i>	.0020	7	10	16	60
<b>TOT</b>	<b>.0279</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

laboratory interaction (*pl*) (Error Type 3). To achieve enhanced prediction/accuracy through the use of serial testing, a single occasion would likely suffice as long as the specimen was sent to multiple laboratories. For Outcome 4, the three way interaction term (*pol*) explains most of the variance and illustrates a possible failure to specify and sample across relevant sources of error. Since the three-way interaction contains un-modeled error as well as the three-way interaction, this outcome may indicate that the variables investigated are not related to observed variation in test results.

#### 4. Discussion

Although the testing problem presented within this hypothetical example focused on the interpretation of a hypothetical diagnostic biomedical test, G theory methodology coupled with Bayes serial estimations has much broader application. For example, many concerned constituents are currently attempting to assure the accurate and fair use of tests in employment, sports eligibility, and in making sanction decisions. In all of these contexts, issues of fairness have arisen due to the large proportion of false positive results and the high stakes nature of the test results. There is considerable interest in increasing the accuracy of test evidence for making important decision or a diagnosis. In addition, in many instances the data for such analyses may already exist since medical

testing companies when seeking FDA approval for a particular test must submit the test to a series of trials.

It is obvious from governing board recommendations and from published legal advice that test users are aware that retesting might reduce error. However, recommendations for retesting are usually made without statistically estimation of the utility of retesting. Suggestions that samples be divided into multiple collection tubes, or that the test be repeated implies an expectation of increased precision with repeated testing. Unfortunately, when the sources of error are not systematically estimated, the usefulness of a particular retesting protocol is currently unknown.

#### REFERENCES

- [1] D. L. Katz "Clinical Epidemiology and Evidence Based Medicine," Sage Publications, Inc., Thousand Oaks, 2001.
- [2] G. A. Diamond, A. Rozanski, J. S. Forrester, D. Morris, B. H. Pollack, H. M. Staniloff, D. S. Berman and H. J. C. Swan, "A Model for Assessing the Sensitivity and Specificity of Tests Subject to Selection Bias," *Journal of Chronic Disease*, Vol. 39, No. 5, 1986, pp. 343-355.
- [3] R. M. Henkelman, I. Kay and M. J. Bronskill, "Receiver Operating Characteristic (ROC) Analysis without Truth," *Medical Decision Making*, Vol. 10, No. 1, 1990, pp. 24-29.
- [4] L. Joseph, T. W. Gyorkos and L. Coupal, "Bayesian Estimation of Disease Prevalence and the Parameters of Diagnostic Tests in the Absence of a Gold Standard," *American Journal of Epidemiology*, Vol. 141, No. 3, 1995, pp. 3546-3553.
- [5] D. Rindskopf and W. Rindskopf, "The Value of Latent Class Analysis in Medical Diagnosis," *Statistics in Medicine*, Vol. 5, No. 1, 1986, pp. 21-27.
- [6] T. A. Alonza and M. Pepe, "Using a Combination of Reference Tests to Assess the Accuracy of a New Diagnostic Test," *Statistics in Medicine*, Vol. 18, No. 22, 1999, pp. 2987-3003.
- [7] S. V. Faraone and M.T. Tsuang, "Measuring Diagnostic Accuracy in the Absence of a 'Gold Standard'," *American Journal of Psychiatry*, Vol. 151, No. 5, 1994, pp. 650-657.
- [8] R. L. Brennan, "Generalizability Theory," Springer Verlag, Inc., New York, 2001.

# Tolerance of the ERP Signatures of Unfamiliar versus Familiar Face Perception to Spatial Quantization of Facial Images\*

Liisa Hanso<sup>1</sup>, Talis Bachmann<sup>1,2</sup>, Carolina Murd<sup>1,2</sup>

<sup>1</sup>University of Tartu, Institute of Psychology, Tartu, Estonia; <sup>2</sup>University of Tartu, Institute of Public Law, Tartu, Estonia.  
Email: talis.bachmann@ut.ee

Received June 4<sup>th</sup>, 2010; revised July 9<sup>th</sup>, 2010; accepted July 12<sup>th</sup>, 2010.

## ABSTRACT

Processing of faces as stimuli is known to be associated with a conspicuous ERP component N170. Processing of familiar faces is found to be associated with an increased amplitude of the ERP components N250r and P300, including when a subject wishes to conceal face familiarity. Leaving facial images without high spatial frequency content by low pass spatial filtering does not eliminate face-perception signatures of ERP. Here, for the first time, we tested whether these facial-processing ERP-signatures can be recorded also when facial images are spatially quantized by pixelation, a procedure where in addition to impoverishment of face-specific information by spatial-frequency filtering a competing masking structure is generated by the square-shaped pixels. We found dependence of N170 expression on level of pixelation and P300 amplitudes dependent on familiarity with 21 pixels-per-face and 11 pixels-per-face images, but not with 6 pixels-per-face images. ERP signatures of facial information processing tolerate image degradation by spatial quantization down to about 11 pixels per face and this holds despite the subject's wish to conceal his or her familiarity with some of the faces.

**Keywords:** Face Recognition, Spatial Quantization, N170, P300, Deception

## 1. Introduction

The ability to identify and discriminate faces is a major research field in cognitive neuroscience, cognitive psychology, artificial pattern recognition and forensic research [1-12]. Advancement of knowledge in this area promises considerable developments and gains in technology, economy, security-state of society, etc. Among several urgent tasks, finding objective and reliable brain-process signatures of face recognition and familiar versus unfamiliar face discrimination can be especially emphasised. *Inter alia*, electroencephalographic (EEG) event related potentials (ERPs) based methods have shown their good applicability for the above-mentioned purposes. EEG/ERP are a relatively cheap, non-invasive, well standardised and internationally quite widespread means to study brain-process signatures of processing meaningful object information, supported by an impressive amount of documented psychophysiological facts

and regularities from basic and applied research.

In practical applications of face recognition research, many directions have emerged and many important results obtained. However, quite many unsolved or unexplored problems remain [2,11]. For example, it may be the case that the images of facial stimuli that are to be shown to perceiving subjects (e.g., in order to evaluate if the subject recognises a face or identifies a familiar face) are degraded due to some technical problems or imperfections. Often the available facial information is represented as a pixelized image with poor resolution. It is useful to know whether these stimuli can be nevertheless used as critical stimuli for testing and expertise and what is the scale of degradation tolerated by the automatic face-processing routines in the brain so that meaningful and actually sensitive ERP signatures of face recognition and/or face familiarity can be still registered and evaluated. Up to now there is no face-identification ERP-research using poor-quality pixelated images.

The three ERP components registered from the human scalp that are strongly involved in face processing are N170, N250r, and P300 [13-18]. N170 is a quite robust

\*This study was supported by Estonian Ministry of Education and Research through Scientific Competency Council (targeted financing research theme SF0182717s06, "Mechanisms of Visual Attention").

signature of facial image processing found in many studies and under a wide variety of facial stimuli, spectral contents of face-images and perceptual tasks [13,16,17, 19-23]. It is a negative potential deflection appearing about 130-200 ms after presentation of a facial stimulus, peaking at about 170 ms. N170 can be best registered from the occipito-temporal, temporal and temporal-parietal electrodes [15,19,24]. It appears that face familiarity does not influence N170 [16,25,26]. N250r is a negative-polarity ERP component that has been related to image-independent representations of familiar faces aiding person recognition [27]. P300 as a positive-polarity potential that appears about 300-500 ms after stimulus presentation is widely accepted as a signature of working-memory analysis involving categorical cognitive processing and comparisons, context updating, resource allocation and meaningfulness evaluation [28,29]. A variety of P300 called P3b which is a signature of categorical, memory dependent processing is best expressed over parietal and temporal-parietal areas. Importantly, the amplitude of the late positive ERP components may be significantly increased when familiar, relevant or attended stimuli (e.g., faces) as opposed to unfamiliar or nonrelevant stimuli are presented [18,30-33]. Because there are many brain sites that increase breadth and amplitude of activity in response to highly meaningful or attention-demanding faces as opposed to less significant faces [34] it is not unanimously agreed upon what are the exact brain sites maximally contributing to the increase in the brain responses to significant faces. Importantly, the increased brain response to more highly meaningful stimuli occurs even when a subject tries to conceal familiarity of a particular stimulus item that reliably has a capacity to lead to an enhanced response such as the P300 amplitude [33]. With familiar faces, P300 may be transformed so that a face-specific negative deflection, N400f precedes typical positivity at about 300-500 ms post stimulus [16]. As mentioned above, it is important to know whether and to what extent ERPs that are sensitive to faces and facial familiarity can be present when facial information is degraded.

Some studies have manipulated facial stimulus-images by filtering out detailed (facial) information by spatial low-pass filtering and then measured subjects' ERP responses [17,20,21,35]. It appears that if only coarse-scale face related spatial information is present, ERPs still differentiate between faces and non-faces and/or between different categorization tasks, with coarse-scale information sometimes leading to relatively better expressed N170 compared to fine-scale faces [20,21,35,36]. However, simple spatial filtering may bring in confounds between image spatial frequency components and lower level features such as luminance and contrast (see, e.g., [37,38] on how to circumvent these problems). It is

therefore important for new studies to use experimental controls over these factors (see our text below).

In practice, security surveillance recordings also often produce facial images that are impoverished, degraded and/or distorted, which makes obstacles for high-quality and reliable evidence-gathering and eyewitness reports [2,11,31]. However, a typical degradation of such images involves not only and not so much spatial low-pass filtering per se, but also often these images are spatially quantized (pixelized) so that in addition to the filtering out of higher spatial frequencies of image content (its fine detail), the mosaic-like structure of the squares produced by the image-processing algorithms that are used in producing pixelised images represents an additional image structure besides the authentic facial low-frequency content [39-43]. This extra image content (squares with vertical and horizontal sharp edges and orthogonal corners; see, e.g., **Figure 1**) provides a competing structure for the perceptual systems of image feature extraction, figure-ground discrimination and visual-categorical interpretation. In a sense, this procedure, in addition to filtering out virtually all of the useful fine-scale information does also something else – it adds also a newly formed masking structure. It is important to know whether brain systems of facial information processing can be immune to this kind of complication or not. Equally important, it would be useful to know whether spatial quantization could change an image in a way that different cues of diagnosticity become to be used, but the ERP signatures of face processing, by using these new cues, may show sensitivity to categorical facial differences (e.g., familiarity). Hypothetically, this may lead to increased categorical sensitivity of ERPs compared to the absence of this kind of sensitivity which has been the case when unquantized, but otherwise filtered face-images have been used [16,25,26]. The existing research literature does not provide an answer to these questions.

Most of the studies of spatially quantised image recognition have been strictly psychophysical – e.g., [39-42]. Up to our knowledge, the only psychophysiological study where spatially quantized images of faces were used was that by Ward [44], but because monkeys were used as perceivers and because only very coarse quantized images with 8 pixels/face or less were used, her findings showing that discrimination between quantized face and nonface stimuli was not possible cannot be strongly generalized.

Coincidentally, spatial manipulation by quantization is free of the methodological problem that accompanies the traditional standard spatial filtering where selectively filtering out certain frequencies may also lead to filtering out luminance and/or local contrast information to a different extent. Because spatial pixelation is based on calculating average luminances within precisely defined

square-shaped areas of the original image, spatially quantized images do not bring in artifacts of unequal luminance filtering.

Face-sensitive bioelectrical signatures of processing heavily rely on configural attributes of facial images, with three main types of configural cues involved [6]: 1) first-order relational processing allowing to specify a stimulus as a face as such, 2) holistic (Gestalt-) processing leading to a mutually supportive, integrated structural set of features, 3) second-order relational processing that uses metric information about spacing of facial features and thus enables discrimination of individual faces. By spatially quantizing faces, and beginning from a relatively coarse level of quantization, we eliminate local featural information and seriously disturb second-order configural processing, at the same time introducing relatively less distortions into first-order and into holistic processing. If it would happen that intermediate level (or even coarse level) spatial quantization does not eliminate face-sensitive ERP signatures and maybe even does not eliminate EEG-sensitivity to the familiarity of faces, then we would show that coarse-scale configural information in the conditions where it is presented within the context of a competing and conflicting structural cues is processed to the extent that allows one to carry out instrumental procedures of detecting (familiar) face detection and discrimination with quantized images.

The present study has two main aims. First, it is to test if spatially quantized images of faces can carry perceptual information sufficient for brain processes to discriminate different classes of facial images and if the answer to this question is positive – to see what is the approximate spatial scale of pixelation coarseness that allows to carry this information. The second aim is to test whether spatially quantized facial images when they can help lead to ERP signatures of face discrimination enable to differentiate familiar face image processing and unfamiliar face image processing in the conditions where the perceiver tries to conceal his/her familiarity with some of the faces. We put forward three general hypotheses. 1. Spatially quantized images of faces as stimuli carry configural information that can be used by brain processes to generate ERP signatures typical for facial image processing (e.g., N170) and can therefore lead to reliable ERP differences as a function of the scale of spatial quantization. 2. Spatially quantized images of faces lead to ERP signatures that are sensitive to face familiarity (e.g., P300) despite that local featural information is filtered out, second-order configural information is distorted and masked and despite that subjects try to conceal their familiarity with some of the stimuli faces. 3. There is a critical level of coarseness of spatial quantization beyond which ERP signatures of processing facial images do not anymore discriminate between familiar and unfamiliar faces.

## 2. Methods

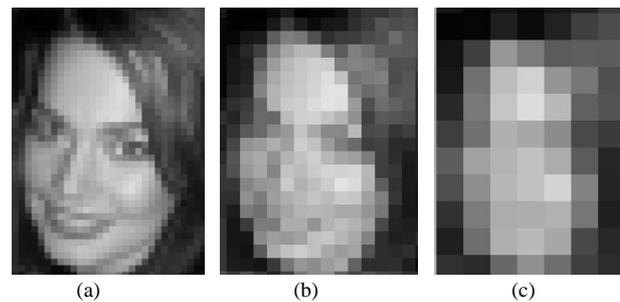
### 2.1 Participants

Six female subjects (age range 20-25 years) who were naïve about the research hypotheses of the present study participated. All had normal or corrected-to-normal vision. The subject sample was selected opportunistically from the pool of bachelor-level students of Tallinn University.

### 2.2 Experimental Setup and Procedure

Frontal images of human faces were used as the visual stimuli. Each subject was presented repeatedly with 6 versions of the facial images of the 2 persons well familiar to them and repeatedly with 30 versions of the facial images of 10 unfamiliar persons. The images subtended  $3.8^\circ \times 5.7^\circ$ . All images were achromatic gray scale images. They varied between three levels of spatial quantization (pixelation by a mosaic transform):  $8 \times 8$  screen-pixels (corresponding to about 21 pixels per face width within the image),  $16 \times 16$  screen-pixels (about 11 pixels per face width), and  $32 \times 32$  screen-pixels (about 6 pixels per face width (**Figure 1**)). (The intermediate level quantization value at 11 pixels/face which is an approximate equivalent of 5.5 cycles/face was chosen to be slightly lower than the 8 cycles/face spatial low-pass filtering used in [20,21] as a border value between high- and low spatial frequency filtered facial images.) The space-average luminances of all stimuli images were set equal at about  $40 \text{ cd/m}^2$ . Stimuli were presented on EIZO Flex-Scan T550 monitor (85 Hz refresh rate).

Stimuli were presented on a computer monitor con-



**Figure 1. Examples of stimuli: (a) pixel size  $8 \times 8$  (approximately 21 pixels/face); (b) pixel size  $16 \times 16$  (approximately 11 pixels/face); (c) pixel size  $32 \times 32$  (approximately 6 pixels/face). In (a), all three basic varieties of configural information (first-order, holistic, second-order) are kept present; in (b), local featural information is filtered out, second-order configural information is strongly distorted, but holistic information kept present; in (c), first-order configural information is considerably degraded, holistic information is severely degraded, and second-order configural information is maximally degraded if not eliminated**

trolled by a custom made VB program at a viewing distance equal to 150 cm. The program and computer regimen allowed necessary synchronization so that no splitting of facial images occurred. Synchronized with face presentation, a trigger signal was sent to the EEG recording system to mark the time each stimulus face was presented. All stimuli were presented in random order, each of them 10 times. (The fact that the probability of seeing a particular familiar face is different from the probability of seeing an unfamiliar face is acceptable because ERP signatures showing tuning to meaningful stimuli are not sensitive to the probability of a stimulus, but are sensitive to the probability of the stimulus class – [28].) Duration of the stimuli was set at 480 ms. There were 360 trials per subject. (As it is known that face-sensitive responses may decrease with stimuli repetition, our design can be acceptable provided that facial stimuli that have different significance and/or meaning for the subject are all similarly susceptible to this decrease. Research based on fMRI and MEG methods has shown this to be the case – [45,46].) Subjects were instructed to “play a game”, meaning that they knew that experimenters tried to use brain EEG-imaging to see whether they can catch if a familiar face was seen, but subjects had to conceal any possible signs of familiarity. Thus subjects were also forced to respond to each face by saying “unfamiliar”. The experiment was run in a double blind protocol so that experimenters who were standing by during the experiment did not know whether a familiar or unfamiliar face was shown at each particular trial.

### 2.3 EEG Recording

EEG was registered by the Nexstim eXimia equipment, with EEG signals’ sampling rate 1450 Hz. For registration of ERPs we used electrodes placed at Oz, O1, O2, P3, P4, T3, T4, TP7, and TP8 (international 10-10 system), with common reference at the forehead; in addition, EOG was registered.

### 2.4 Data Analysis

For EEG data processing, Brain Vision Analyzer 1.05 was used. For processing the raw EEG data for ERPs, a high-cutoff 30-Hz filter was used. To obtain ERPs, EEG signal was segmented according to 900 ms peristimulus epochs (from -200 ms pre-stimulus to +700 ms post-stimulus). Eye-movement artefacts were eliminated using Brain Vision Analyzer custom Gratton and Coles algorithm. The EEG data for obtaining ERPs was pooled for selected regional electrodes and thus 3 conditional regional ERPs were computed: O (pooled electrodes O1, O2, Oz), T (electrodes T3, T4), and TP (electrodes TP7, TP8, P3, P4). ERPs were baseline corrected (-100-0 ms). In the analysis, we concentrated on ERP components N170 and P300.

### 2.5 Statistical Analysis

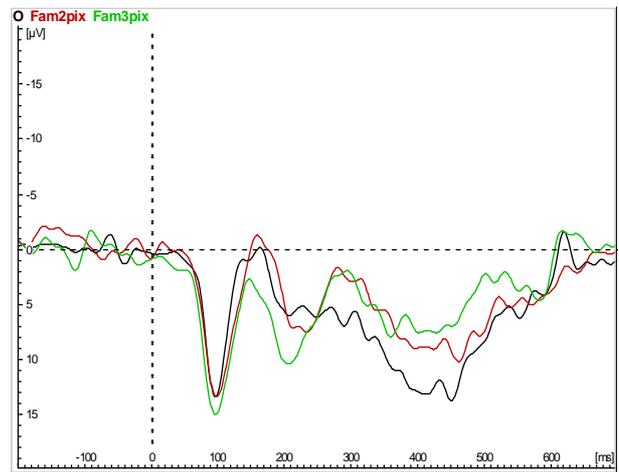
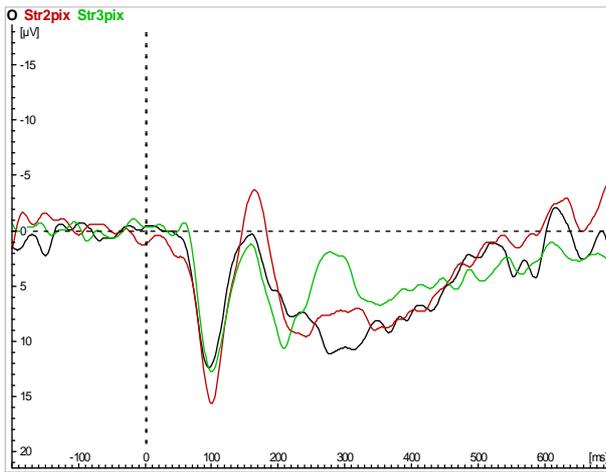
ERP components’ mean amplitude data gathered from different subjects and different experimental conditions was subjected to ANOVA, with factors spatial quantization (3 levels) and familiarity (2 levels). Main effects as well as interactions were tested for significance.

### 3. Results

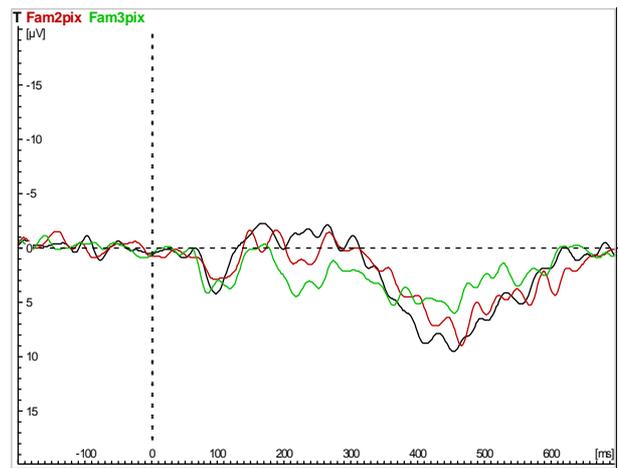
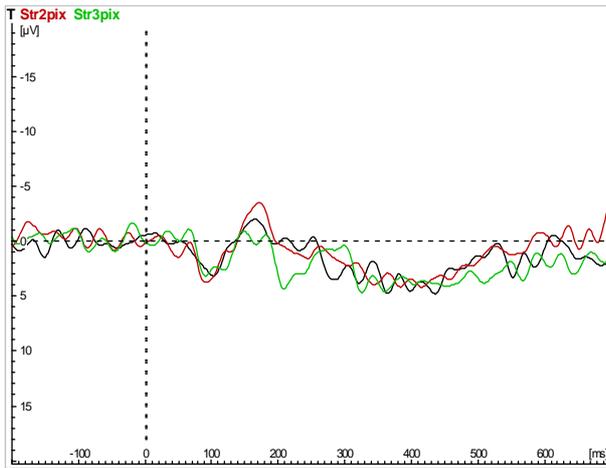
There are no behavioral results to be reported separately from ERP results because subjects equally and systematically answered “No” to each of the presented quantized faces and tried not to display any signs of possible familiarity with some of the faces. **Figure 2** depicts grand average ERPs obtained from generalized regions O, T, and TP as a function of level of pixelation; ERPs are shown separately for unfamiliar faces (ERP functions on the left) and for familiar faces (ERP functions on the right). As seen from **Figure 2**, distinct ERP components P100, N170 and P300 are produced for quantized faces as the visual stimuli.

#### 3.1 N170 Amplitude

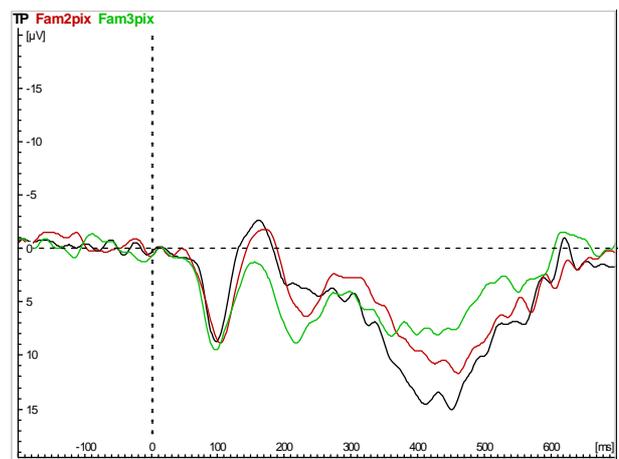
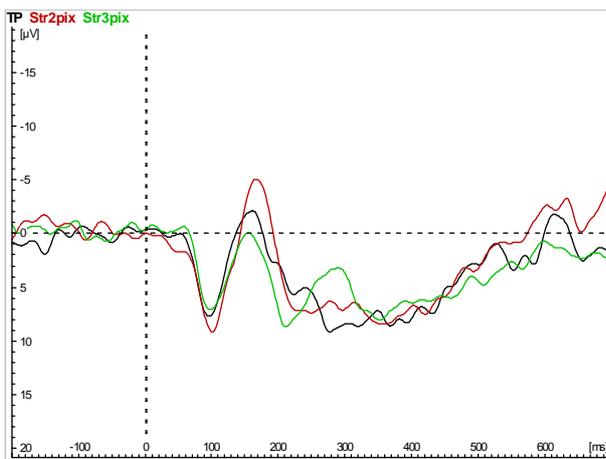
ERPs from all recording sites showed distinctive N170 in responses to faces. However, there were only few statistically significant effects involving our experimental factors. Measured from the occipital electrodes, the effect of level of pixelation proved to be significant [ $F(2, 34) = 6.674, P = 0.014$ ]. The coarsest quantized facial images (6 pixels/face) were associated with the lowest N170 amplitude. The intermediate level quantized facial images (11 pixels/face) were associated with at least as high N170 amplitude as the finest level quantized facial images (21 pixels/face). Brain systems that process facial information and participate in occipital N170 generation tolerate spatial quantization of facial images up to about 11 pixels per face (along the horizontal dimension). Measured from the temporal-parietal electrodes, the effect of level of pixelation on N170 was highly significant [ $F(2, 46) = 7.12, P = 0.006$ ], showing that intermediate and fine quantized facial images are associated with larger N170 amplitude than coarse quantized images. Interestingly, there was a highly significant interaction between level of quantization and familiarity [ $F(2, 46) = 7.105, P = 0.004$ ]. With unfamiliar faces the intermediate-level quantized images lead to highest N170 amplitude while with familiar faces this trend was reversed. The effect of familiarity depends on pixelation level and cannot be considered as a simple additive effect. (When measured from the temporal electrodes, there were no significant main effects of pixelation or familiarity on N170 or significant interaction effects. For level of pixelation,  $F(2, 22) = 2.895$ ; for familiarity,  $F(1, 11) = 0.87, P = 0.371$ ; interaction  $F(2, 22) = 1.274, P = 0.298$ .)



**O-electrodes**



**TP-electrodes**



**TP-electrodes**

**Figure 2. Grand average ERPs registered from occipital, temporal and temporal-parietal pooled electrodes (negativity up). Distinct P100, N170 and P300 can be seen. Left column – unfamiliar; right column – familiar. For 21 pixels/face images condition ERPs drawn in black; for 11 pixels/face ERPs in red; for 6 pixels/face ERPs in green**

### 3.2 P300 Amplitude

As measured from occipital electrodes, the effect of pixelation level on P300 amplitude was highly significant [ $F(2, 34) = 10.644, P = 0.002$ ] while the effect of familiarity was expressed as a trend [ $F(1, 17) = 3.871, P = 0.066$ ]. Familiar faces lead to higher P300 amplitude. There was a highly significant interaction between level of pixelation and familiarity [ $F(2, 46) = 10.366, P < 0.001$ ]. With familiar faces, the finest level of pixelation lead to P300 amplitude that was distinctly larger than amplitudes for intermediate level and coarse level quantized images; with unfamiliar faces the finest scale and intermediate scale quantized images lead to relatively similar amplitudes of P300 whereas the P300 amplitude value stood apart from the other two quantization levels. As measured from temporal-parietal electrodes, the effects were significant or highly significant: level of pixelation [ $F(2, 46) = 6.687, P = 0.006$ ], familiarity [ $F(1, 23) = 6.923, P < 0.15$ ], interaction between pixelation and familiarity [ $F(2, 46) = 10.366, P < 0.001$ ]. All three levels of pixelation lead to mutually distinctive amplitudes of P300, with the value of amplitude being the largest, the less coarse the pixelation, but this effect was expressed only with familiar faces. The P300 amplitude had a comparable magnitude for all levels of pixelation with unfamiliar faces (see also **Figure 2**). As measured from temporal electrodes, no significant effects of any of the factors, nor significant interaction, were found (for pixelation,  $F(2, 22) = 0.199, P = 0.773$ ; for familiarity,  $F(1, 11) = 1.789, P = 0.208$ ; interaction,  $F(2, 22) = 1.641, P = 0.218$ ).

### 4. Discussion

Our results support our hypotheses: 1) Spatially quantized images of faces do carry configural information which is used by brain processes to generate ERP signatures typical for facial image processing (e.g., N170). The coarseness range of spatial quantization capable of communicating facial configuration includes 11 pixels/face images (an equivalent of 5.5 cycles/face) or finer. 2) Spatially quantised images of faces lead to ERP signatures that are sensitive to face familiarity (e.g., P300); this is despite that local featural information is filtered out, second-order configural information is distorted and that subjects try to conceal their familiarity with some of the stimuli-faces. However, the familiarity effect is reliably expressed when measured from the temporal-parietal electrode locations, but could not be easily obtained from the occipital and temporal electrodes. 3) There is a critical level of coarseness of spatial quantization beyond which ERP signatures of processing facial images do not anymore discriminate between familiar and unfamiliar faces. The familiarity effect does not tolerate coarseness

of quantization set at less than 11 pixels/face.

If the square-shaped pixel size in our images was  $8 \times 8$  screen-pixels, this amounted to about 21 pixels per face quantization (an equivalent of about 10.5 cycles/face). With this level of image detail, all three basic varieties of configural information (first-order, holistic, second-order – [6]) are kept present. (See also **Figure 1**.) If the pixel size was  $16 \times 16$  screen pixels, this corresponded to about 11 pixels per face quantization (roughly 5.5 cycles/face). According to our evaluation, this is sufficient in order to filter out local featural information, appropriate for strong distortion of second-order configural information, but allowing holistic information to remain present in the image. If pixel size of  $32 \times 32$  screen pixels was used, a quantized face image with about 6 pixels per face was created (roughly 3 cycles/face). In that case, first-order configural information is considerably degraded, holistic information is severely degraded, and second-order configural information is maximally degraded if not eliminated. Because familiarity effects were obtained with 21- and 11- pixels-per-face images and not with 6- pixels-per-face images and because there was an interaction between ERP P300 amplitudes and familiarity, we can conclude that facial familiarity information was carried primarily by second-order configural cues. Whereas it is likely that a face is categorized as belonging to the class of familiar faces only after the cues that allow face individuation had been discriminated, the dependence of the familiarity effect on second-order configural processing is a viable theoretical conclusion. On the other hand, the absence of main effects of familiarity on N170 together with the sensitivity of N170 to the change of spatial quantization between 11 pixels/face and 6 pixels/face levels altogether indicate that this ERP-component is especially sensitive to the first-order configural cues. Some other works have supported both of these ideas [6,16,25].

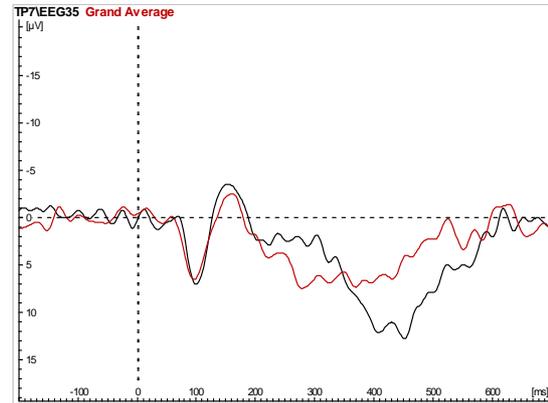
It has been usually accepted that N170 is insensitive to face familiarity [16,25,26]. Our results are consistent with this in general terms. One minor exception to this rule can be noticed when we remember that there was a significant interaction between familiarity and pixelation level with temporal-parietal electrodes. Unfamiliar faces produced expected effects, showing higher N170 amplitude with systematically finer facial stimuli. This can be explained as better detection of facial first-order configural cues and also holistic templates when image detail gets finer and the competing structure of the square-shaped pixels' mosaic gradually loses its distracting power. However, with familiar faces the finest quantization did not lead to a highest N170 peak amplitude. One possible explanation could assume that 11 pixels/face and 21 pixels/face quantization levels in case of familiar faces are equally efficient for individual face

recognition because of equal ease with which first-order facial configural representations are activated. This may be a result of formation of some habitual, automatic link between second-order featural configuration representation and first-order facial templates. This speculation should be tested in specific experiments in future.

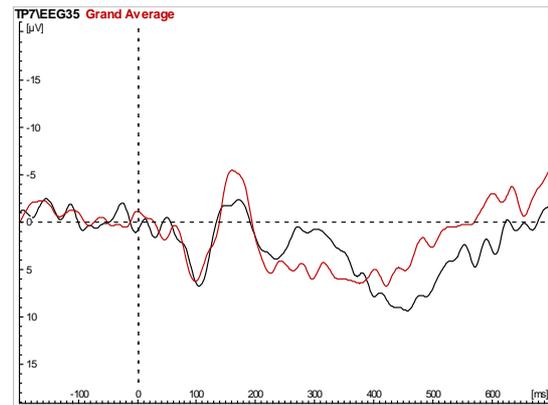
Somewhat surprisingly, the finest level of quantization when applied to familiar faces lead to highest P300 amplitude also as measured from the occipital electrodes (with unfamiliar faces, the finest and the intermediate level quantization yielded equal P300 amplitudes). Although the cortical site of this effect was surprising, the direction of the effect supported the conclusion about second-order and featural information being the basis of familiarity effects. Fine quantization level allows visual system to recognize a familiar face with high certainty, which in turn can capture attentional processes to a stronger degree. Indeed, as shown by [30], focusing attention on certain facial cues enhances the P300 amplitude.

Our design presupposed repetitive presentation of familiar and unfamiliar faces, appearing in random order and varying in the low-level attributes which was caused by the varying levels of quantization. This means at least two things. First, while sometimes familiar faces appeared successively, but even in the more often occurring cases they appeared after a few unfamiliar faces had intervened. Thus, this design may be appropriate for finding a certain definite signature of face processing that seems to be sensitive to face familiarity of successively presented faces and that presupposes parietal involvement -- the N400f [16]. Yet, our statistical analyses did not succeed in disentangling this component as a statistically significant one (see also **Figure 2**). Secondly, because in our experiment the same original faces, when quantized at varying levels, were depicted as different low-level images, they should have enabled generation of ERP components that are sensitive to invariant face recognition with varying low-level attributes of the corresponding facial images. Because familiarity presupposes recognition (in addition to detection) and because some of the ERP signatures that are specific to individual face processing are image-independent (in terms of image low-level characteristics) and explicable when no more than only a few items intervene, we should be able to observe such signatures in our ERPs also. The ERP component N250r is known to satisfy the above criteria [18,27]. Unfortunately, our statistical analyses did not succeed in finding any reliable effects of N250r. On the other hand, if we observe **Figure 3** where ERPs with strong parietal and temporal involvement are depicted, we see that familiar face perception is associated with a visibly stronger negativity between 200 ms and 350 ms post-stimulus (and only with fine and intermediate scale

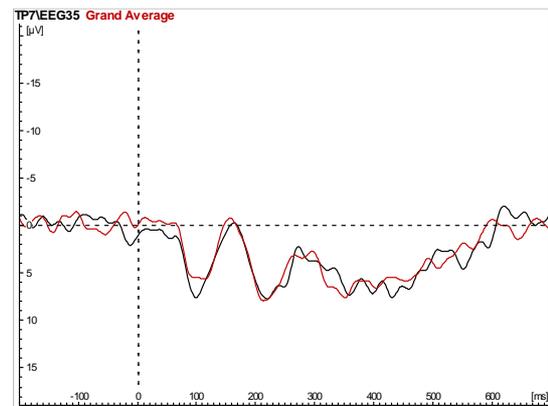
pixelation, but not with coarse quantized images). Hopefully, subsequent studies when especially targeted on this observation could produce reliable statistical effects.



(a)



(b)



(c)

**Figure 3.** ERPs recorded from TP7, depicted for fine-scale quantization; (a) intermediate level quantization; (b) and coarse-scale quantization; (c) conditions. Familiar faces – ERPs in black; unfamiliar faces – ERPs in red. With (a) and (b), familiar faces lead to some N250f-like ERP deflections

The ERPs that discriminated between familiar and unfamiliar faces were found with face-image pixelation at 11 pixels/face and above, but not with 6 pixels/face images. This specific value of difference when it sets the images with above 10 pixels/face quantization apart from the rest approximately corresponds to the critical pixelation values found in behavioural studies of face identification [39,40]. This may mean that processing familiar facial information from the spatially quantized images requires that subjects can explicitly discriminate these quantised images in terms of their facial identity. On the other hand, when gathering introspective reports from the subjects after they completed the experiment, it appeared that some of the actually familiar faces, when quantized at the intermediate level were not recognized as familiar. It should be important to carry out further studies in order to ascertain if ERPs could reflect face familiarity even with explicitly unrecognized facial images. In addition to theoretical significance of this question it may be valuable to solve it also for applied purposes. For example, a need may emerge to test whether a person is familiar with some individuals whose low-quality photographs are available and where, therefore, this person has no explicit awareness of what is depicted in the picture. Another applied aspect related to our results is even simpler: we have shown that spatially quantized (pixelated) images can be used for registration and analysis of face-sensitive ERPs. This in itself is encouraging.

## 5. Conclusions

As was stated in the introductory part, spatial quantization is an image transform with effects ranging beyond simple spatial-frequency filtering. The structure of the square-shaped pixels with their square-corners, square-edges and formal aspects of the mosaic of square-shapes provides a visual structure that 1) masks facial configural cues and 2) sets visual system at the competing demands of image interpretation – a face versus a mosaic. In these circumstances there are no strong *a priori* foundations to expect an inevitable capability of the visual processing system to extract face-specific information sufficient for generation of known face-specific and/or face-sensitive ERP signatures on the face of the pixelised masking structure. Our study showed that spatial quantization does not make an obstacle for the emergence of ERP-signs of facial processing, including the ones sensitive to face familiarity. However, this sensitivity has its limits so that with pixelation coarseness approaching 6 pixels per face, familiarity effects on ERP disappear.

## 6. Acknowledgements

We are grateful to Jaan Aru for his substantial help during preparation of this report.

## REFERENCES

- [1] V. Bruce and A. Young, "In the Eye of the Beholder: The Science of Face Perception," Oxford University Press, Oxford, 1998.
- [2] A. M. Burton, S. Wilson, M. Cowan and V. Bruce, "Face Recognition in Poor-Quality Video," *Psychological Science*, Vol. 10, No. 3, 1999, pp. 243-248.
- [3] T. A. Busey and G. R. Loftus, "Cognitive Science and the Law," *Trends in Cognitive Sciences*, Vol. 11, No. 3, 2007, pp. 111-117.
- [4] C. G. Gross, "Processing the Facial Image: A Brief History," *American Psychologist*, Vol. 60, No. 8, 2005, pp. 755-763.
- [5] S. Z. Li and A. K. Jain, "Handbook of Face Recognition," Springer-Verlag, Berlin, 2005.
- [6] D. Maurer, R. Le Grand and C. J. Mondloch, "The Many Faces of Configural Processing," *Trends in Cognitive Sciences*, Vol. 6, No. 6, 2002, pp. 255-260.
- [7] C. Peacock, A. Goode and A. Brett, "Automatic Forensic Face Recognition from Digital Images," *Science and Justice*, Vol. 44, No. 1, 2004, pp. 29-34.
- [8] P. Quintiliano and A. Rosa, "Face Recognition Applied to Computer Forensics," *International Journal of Forensic Computer Science*, Vol. 1, 2006, pp. 19-27.
- [9] S. S. Rakover and B. Cahlon, "Face Recognition: Cognitive and Computational Processes," John Benjamins Publishing, Amsterdam, 2001.
- [10] A. Schwaninger, C. Wallraven, D. W. Cunningham and S. D. Chiller-Glaus, "Processing of Facial Identity and Expression: A Psychophysical, Physiological and Computational Perspective," *Progress in Brain Research*, Vol. 156, 2006, pp. 321-343.
- [11] P. Sinha, "Recognizing Complex Patterns," *Nature Neuroscience Supplement*, Vol. 5, 2002, pp. 1093-1097.
- [12] M.-H. Yang, D. J. Kriegman and N. Ahuja, "Detecting Faces in Images: A Survey," *IEEE Transactions on Pattern Analysis and Machine Intelligence*, Vol. 24, No. 1, 2002, pp. 34-58.
- [13] T. H. Allison, G. Ginter, A. C. McCarthy, A. Nobre, M. Puce, D. Luby and D. D. Spencer, "Face Recognition in Human Extrastriate Cortex," *Journal of Neurophysiology*, Vol. 71, No. 2, 1994, pp. 821-825.
- [14] S. G. Boehm and W. Sommer, "Neural Correlates of Intentional and Incidental Recognition of Famous Faces," *Cognitive Brain Research*, Vol. 23, No. 2-3, 2005, pp. 153-163.
- [15] M. Eimer and R. A. McCarthy, "Prosopagnosia and Structural Encoding of Faces: Evidence from Event-Related Potentials," *NeuroReport*, Vol. 10, No. 2, 1999, pp. 255-259.
- [16] M. Eimer, "Event-Related Brain Potentials Distinguish Processing Stages Involved in Face Perception and Recognition," *Clinical Neurophysiology*, Vol. 111, No. 4, 2000,

- pp. 694-705.
- [17] A. Holmes, J. S. Winston and M. Eimer, "The Role of Spatial Frequency Information for ERP Components Sensitive to Faces and Emotional Facial Expression," *Cognitive Brain Research*, Vol. 25, No. 2, 2005, pp. 508-520.
- [18] S. R. Schweinberger, E. C. Pickering, I. Jentzsch, A. M. Burton and J. M. Kaufmann, "Event Related Potential Evidence for a Response of Interior Temporal Cortex to Familiar Face Repetitions," *Cognitive Brain Research*, Vol. 14, 2002, pp. 398-409.
- [19] S. Bentin, T. Allison, A. Puce, E. Perez and G. McCarthy, "Electrophysiological Studies of Face Perception in Humans," *Journal of Cognitive Neuroscience*, Vol. 8, No. 6, 1996, pp. 551-565.
- [20] V. Goffaux, I. Gauthier and B. Rossion, "Spatial Scale Contribution to Early Visual Differences between Face and Object Processing," *Cognitive Brain Research*, Vol. 16, No. 3, 2003, pp. 416-424.
- [21] V. Goffaux, B. Jemel, C. Jacques, B. Rossion and P. G. Schyns, "ERP Evidence for Task Modulations on Face Perceptual Processing at Different Spatial Scales," *Cognitive Science*, Vol. 27, No. 2, 2003, pp. 313-325.
- [22] B. Rossion, I. Gauthier, M. J. Tarr, P. A. Despland, R. Bruyer, S. Linotte and M. Crommelinck, "The N170 Occipito-Temporal Component is Enhanced and Delayed to Inverted Faces but not to Inverted Objects: An Electrophysiological Account of Face-Specific Processes in the Human Brain," *Neuroreport*, Vol. 11, No. 1, 2000, pp. 69-74.
- [23] G. A. Rousselet, M. J. Macé and M. Fabre-Thrope, "Animal and Human Faces in Natural Scenes: How Specific to Human Faces is the N170 ERP Component?" *Journal of Vision*, Vol. 4, No. 1, 2004, pp. 13-21.
- [24] J. M. Kaufmann and S. R. Schweinberger, "Distortions in the Brain? ERP Effects of Caricaturing Familiar and Unfamiliar Faces," *Brain Research*, Vol. 1228, 2008, pp. 177-188.
- [25] S. Bentin and S. Y. Deouell, "Structural Encoding and Identification in Face Processing: ERP Evidence for Separate Mechanisms," *Cognitive Neuropsychology*, Vol. 17, No. 1-3, 2000, pp. 35-54.
- [26] B. Rossion, S. Campanella, C. M. Gomez, A. Delinte, D. Debatisse, L. Liard, S. Dubois, R. Bruyer, M. Crommelinck and J.-M. Guérit, "Task Modulation of Brain Activity Related to Familiar and Unfamiliar Face Processing: An ERP Study," *Clinical Neurophysiology*, Vol. 110, No. 3, 1999, pp. 449-462.
- [27] M. Bindemann, A. M. Burton, H. Leuthold and S. R. Schweinberger, "Brain Potential Correlates of Face Recognition: Geometric Distortions and the N250r Brain Response to Stimulus Repetitions," *Psychophysiology*, Vol. 45, No. 4, 2008, pp. 535-544.
- [28] S. J. Luck, "An Introduction to the Event-Related Potential Technique," MIT Press, Cambridge, 2005.
- [29] J. Polich and J. R. Criado, "Neuropsychology and Neuropharmacology of P3a and P3b," *International Journal of Psychophysiology*, Vol. 60, No. 2, 2006, pp. 172-185.
- [30] R. N. Henson, Y. Goshen-Gottstein, T. Ganel, L. J. Otten, A. Quayle and M. D. Rugg, "Electrophysiological and Haemodynamic Correlates of Face Perception, Recognition and Priming," *Cerebral Cortex*, Vol. 13, No. 7, 2003, pp. 793-805.
- [31] E. Mercure, F. Dick and M. H. Johnson, "Featural and Configural Face Processing Differentially Modulate ERP Components," *Brain Research*, Vol. 1239, 2008, pp. 162-170.
- [32] E. I. Olivares and J. Iglesias, "Brain Potentials and Integration of External and Internal Features into Face Representations," *International Journal of Psychophysiology*, Vol. 68, No. 1, 2008, pp. 59-69.
- [33] J. P. Rosenfeld, J. R. Biroshak and J. J. Furedy, "P300-Based Detection of Concealed Autobiographical versus Incidentally Acquired Information in Target and Non-Target Paradigms," *International Journal of Psychophysiology*, Vol. 60, No. 3, 2006, pp. 251-259.
- [34] A. Ishai, C. F. Schmidt and P. Boesiger, "Face Perception is Mediated by a Distributed Cortical Network," *Brain Research Bulletin*, Vol. 67, No. 1-2, 2005, pp. 87-93.
- [35] H. Halit, M. de Haan, P. G. Schyns and M. H. Johnson, "Is High-Spatial Frequency Information Used in the Early Stages of Face Detection?" *Brain Research*, Vol. 1117, No. 1, 2006, pp. 154-161.
- [36] A. V. Flevaris, L. C. Robertson and S. Bentin, "Using Spatial Frequency Scales for Processing Face Features and Face Configuration: An ERP Analysis," *Brain Research*, Vol. 1194, 2008, pp. 100-109.
- [37] T. Nakashima, K. Kaneko, Y. Goto, T. Abe, T. Mitsudo, K. Ogata, A. Makinouchi and S. Tobimatsu, "Early ERP Components Differentially Extract Facial Features: Evidence for Spatial Frequency-and-Contrast Detectors," *Neuroscience Research*, Vol. 62, No. 4, 2008, pp. 225-235.
- [38] G. A. Rousselet, J. S. Husk, P. J. Bennett and A. B. Sekuler, "Time Course and Robustness of ERP Object and Face Differences," *Journal of Vision*, Vol. 8, No. 12, 2008, pp. 1-18.
- [39] T. Bachmann, "Identification of Spatially Quantised Tachistoscopic Images of Faces: How Many Pixels does it Take to Carry Identity?" *European Journal of Cognitive Psychology*, Vol. 3, No. 1, 1991, pp. 87-103.
- [40] S. K. Bhatia, V. Lakshminarayanan, A. Samal and G. V. Welland, "Human Face Perception in Degraded Images," *Journal of Visual Communication and Image Representation*, Vol. 6, No. 3, 1995, pp. 280-295.
- [41] N. P. Costen, D. M. Parker and I. Craw, "Spatial Content and Spatial Quantisation Effects in Face Recognition," *Perception*, Vol. 23, No. 2, 1994, pp. 129-146.
- [42] L. D. Harmon and B. Julesz, "Masking in Visual Recognition: Effects of Two-Dimensional Filtered Noise," *Science*, Vol. 180, No. 4091, 1973, pp. 1194-1197.

- [43] K. Lander, V. Bruce and H. Hill, "Evaluating the Effectiveness of Pixelation and Blurring on Masking the Identity of Familiar Faces," *Applied Cognitive Psychology*, Vol. 15, No. 1, 2001, pp. 101-116.
- [44] E. J. Ward, "Effects of Two-Dimensional Noise and Feature Configuration on the Recognition of Faces in Capuchin Monkeys (*Cebus apella*)," Biological Foundations of Behavior: 490 Honors Thesis, Franklin & Marshall College, Lancaster, 2007.
- [45] H. Fischer, C. I. Wright, P. J. Whalen, S. C. McInerney, L. M. Shin and S. L. Rauch, "Brain Habituation during Repeated Exposure to Fearful and Neutral Faces: A Functional MRI Study," *Brain Research Bulletin*, Vol. 59, No. 5, 2003, pp. 387-392.
- [46] A. Ishai, P. C. Bickle and L. G. Ungerleider, "Temporal Dynamics of Face Repetition Suppression," *Brain Research Bulletin*, Vol. 70, No. 4-6, 2006, pp. 289-295.

# Is a Divergent Central Serotonergic Activity Responsible for Either Despair or Learning Behavior in Intact Wistar or Sprague-Dawley CD Rats, Respectively? A Concomitant Behavioral and Electrochemical Analysis

Francesco Crespi

Biology Department, Neurosciences CEDD GlaxoSmithKline, Medicines Research Centre, Verona, Italy.  
Email: francesco.m.crespi@gsk.com

Received May 11<sup>th</sup>, 2010; revised June 28<sup>th</sup>, 2010; accepted June 30<sup>th</sup>, 2010.

## ABSTRACT

*Behavioral observations combined with electrochemical analysis have been performed in Wistar or Sprague-Dawley CD rats in the attempt to clarify earlier controversial behavioral reports. In particular, these rats were submitted to FST and to repeated Forced Swimming (rFS, during 4 days). In parallel, voltammetric in vivo analysis of serotonin (5-HT) levels in platelet-rich plasma (PRP) collected daily from these animals was also performed as it is known that peripheral 5-HT levels monitored in rat PRP mirror cerebral 5-HT contents. Thus, combined behavioral-voltammetric studies allow deducing changes of central 5-HT levels that could be correlated to FST or rFS, with the advantage of non invasive analysis of central neurotransmitter activities in intact behaving animals. In particular, combined behavioral-voltammetric results suggest that “behavioral despair” is the process interesting Wistar rats when submitted to FST or rFS while “learning to be immobile” is the process involving Sprague-Dawley CD rats.*

**Keywords:** Rat Strains, Behavior, Electrochemistry, Fluoxetine, Serotonin, Platelets

## 1. Introduction

Many studies employing the forced swimming test (FST) which is a behavioral test that predicts the clinical efficacy of many types of antidepressant drugs [1] have been done using Sprague-Dawley CD rats. A minor number of such experiments have been done in Wistar rats. In the Sprague-Dawley CD strain of rodents submitted to FST in 15 cm water depth [2-5] or 30 cm water depth [6-10] an antidepressant drug such as the selective serotonin reuptake inhibitor (SSRI) fluoxetine produced dose-dependent reduction of immobility at doses ranged between 5 or 80 mg/kg.

An antidepressant drug such as the selective serotonin reuptake inhibitor (SSRI) fluoxetine at doses ranged between 5 or 80 mg/kg produced dose-dependent reduction of immobility in Sprague-Dawley CD rats submitted to FST performed in 15 cm water depth [2-5] or in 30 cm water depth [6-10]. In contrast, treatment with fluoxetine increased immobility in Wistar rats tested in deep water

(30 cm) [11,12] while a decrease or no modification of immobility was monitored when FST was performed in 15 cm water depth [13,14]. Thus, following treatment with fluoxetine, differences in immobility behavior between these two strains of rodents appear when tested in lower water (15 cm) and become evident when tested in deeper water (30 cm). Again, in Sprague-Dawley CD rats peripheral fluoxetine (from 5 to 20 mg/kg) significantly and dose-dependently increased swimming behavior [6,7, 11] while in Wistar rats only the highest dose of fluoxetine did so [11]. Conversely, fluoxetine did not alter climbing at any dose tested (5-80 mg/kg) in any of the two rat species [4,6,8-11].

It is known that the swimming behavior is closely related to the activity of cerebral 5-HT [4,6]. Thus, one can propose that the different sensitivity to fluoxetine behaviorally displayed by the two strains may be related to dissimilarity within their serotonergic system.

The current study has been undertaken to analyse this hypothesis. Sprague-Dawley and Wistar rats have been

submitted to FST in deep water (30 cm) after intraperitoneal treatment with saline (vehicle) or with fluoxetine 20 mg/kg as this appears to be the dose significantly affecting the swimming behavior within both types of rodents [11]. Deep water has been selected as in such conditions rats cannot support themselves by touching the ground and they are obliged to swim and/or climb more actively [4,6]. Furthermore, the duration of the swimming test was prolonged up to a total of 4 days [15]. This has been done since previous reports have observed development of habituation in Wistar rats submitted to repeated FST [16-18] and that pharmacological blockade of serotonergic activity enhances learning and memory skills [19,20]. Those reports were followed by other studies with the subsequent suggestion that the process involved in FST could be "learning to be immobile" [21,22] more than "behavioral despair" [1,3,4]. In the present work, application of rFS to Sprague-Dawley and Wistar rats together with electrochemical analysis of *in vivo* serotonergic activities would investigate this hypothesis. In particular, voltammetric measurements of 5-HT have been performed in PRP obtained from blood collected from the tail vein of naive or "treated" conscious Sprague-Dawley or Wistar rats, daily.

Many clues in the literature suggest that "peripheral" 5-HT monitored in PRP is directly related to the levels of cerebral 5-HT [23-27]. The feasibility of selective monitoring of 5-HT by means of voltammetry together with specifically treated carbon fibre micro-electrodes (mCFE) has been demonstrated either in brain as well as in blood [28-32]. Furthermore, we have demonstrated that peripheral 5-HT levels monitored by means of differential pulse voltammetry (DPV) together with mCFE in rat PRP mirror cerebral 5-HT contents [28]. Therefore, in the present work, this electrochemical methodology has been applied to analyze daily the influence of behavioral-pharmacological tests upon *in vivo* serotonergic levels in the PRP of conscious rats. Substantially, monitoring "peripheral" 5-HT in PRP in alternative to the analysis of cerebral 5-HT avoids submitting the rats to: 1) Surgery performed under major reversible anesthesia *i.e.* chloral hydrate [33,34] for implantation of the mCFE within the brain; 2) Daily substitution of the exhausted mCFE, performed under halotane anesthesia, when central 5-HT is monitored chronically [35].

## 2. Material and Methods

### 2.1 Animals

Male Sprague-Dawley CD rats and male Wistar rats (200-250g) were supplied by Charles-River (Italy) and were kept in temperature- and humidity-controlled rooms (22°C, 50%) with lights on from 0700 to 1900 hours with water and food available *ad libitum*. All procedures were

carried out in accordance with the Italian law (Legislative Decree no.116, 27 January 1992), which acknowledges the European Directive 86/609/EEC, and were fully compliant with GlaxoSmithKline policy on the care and use of laboratory animal and codes of practice. Furthermore, all efforts were made to minimize the number of animals used and their suffering.

### 2.2 Behaviour Studies

Rats were exposed to FST according to Porsolt *et al.* [1] except that the water was deeper so that rats cannot modify the effects of the forced swim by developing behavioral adaptations, such as when they touch the bottom or sides of the tank. Briefly, the animals were placed individually into a cylinder glass tank [40 cm height; 20 cm diameter] containing water 30 cm deep and at 23-25°C according to Detke *et al.* [6] and Detke & Lucki [4]. Two swim sessions were conducted *i.e.* a 15-min pre-test followed 24 h later by a 5-min test.

Separate groups of rats received intraperitoneally either saline (Sprague-Dawley CD rats *n* = 5; Wistar rats *n* = 5) or fluoxetine 20 mg/kg (Sprague-Dawley CD rats *n* = 6; Wistar rats *n* = 6) in a volume of 2 ml/kg. Each treatment was administered 23 h, 5 h and 1 h prior to the test as described earlier [4,6]. The 20 mg/kg dose of fluoxetine was also chosen because it has been demonstrated that in some animal models of anxiety, acute fluoxetine treatment may elicit a bell-shaped dose-response curve with a maximum effect at 20 mg/kg [36].

Other 5 Sprague-Dawley rats and 5 Wistar rats were exposed to a modified FST on four consecutive days. The modified test was called rFS as described earlier [15-17]. On the first day of rFS, rats swam for 15 min. subsequently they were removed from the water tank and dried under warm air. Other three swimming sessions of 5 min each were then conducted (spaced 24 h apart) on the following three days.

A time-sampling method was used as described previously [6] in order to score several behaviors during a single viewing. This method has been selected as it has shown to be reliable and valid for detecting the effect of different antidepressant drugs. In particular, immobility, swimming and climbing was monitored in 5-sec period. Briefly, immobility was scored when the animal was making the minimum movements necessary to keep its head above water and stay afloat. Swimming was scored when the animal actively swam around the tank, making movements greater than that necessary to stay afloat. Climbing was scored when the animal made vigorous thrashing movements with its forepaws in and out of water. It was usually directed against the wall of the tank. All the watching and scoring were performed by the

same observer within the behavior tests.

### 2.3 Voltammetric Studies

Immediately after each forced swimming session, each rat was submitted to short (approximately 20 sec), light halotane anesthesia so that blood can be collected from tail vein (approximately 1ml/daily). The blood was centrifuged 15 min at 200xg at room temperature to obtain plasma rich-platelets (PRP) as described previously [37]. Successively, PRP was aspirated and re-suspended in PBS pH 7.4. Then, mCFE coated with Nafion (Nafion-mCFE) in order to selectively monitor serotonin [29,31, 38-41] were used in association with DPV to measure 5-HT content within PRP. More precisely, the mCFE and the other two electrodes needed to apply DPV: the auxiliary and the reference electrode [30,42] were inserted in 200 $\mu$ l PRP obtained either from rats undergoing the behavioral test (rFS) or from naïve, control rats.

In order to verify the chemical nature of the DPV signal monitored in PRP as corresponding to the oxidation of 5-HT, the following experiments have been performed:

- 1) Addition of standard serotonin solution to PRP preparation;
- 2) Incubation during 10 min at room temperature in three KCl solutions (150  $\mu$ M, 15 mM or 150 mM, respectively).
- 3) Incubation during 10 min at room temperature in three EGTA solutions (3, 10, or 30 mM, respectively).

### 2.4 Data Analyses

All data were averaged and were expressed in percent of:

- 1) The averaged control 5-HT basal levels in the voltammetric analysis;
- 2) The averaged count of immobility behavior in vehicle treated rats in the FST study;
- 3) The averaged count of different behaviors of day 1 in the rFS study, respectively. However, the statistics were calculated from the raw data using repeated measures analysis of variance (two ways ANOVA) with STATISTICA software version 6.0. In the case of statistically significant differences between mean values produced by drug treatments versus controls (vehicle treatment) main factor Dunnet *post-hoc* test was applied. Statistical significance was set at  $p < 0.05$ .

## 3. Results

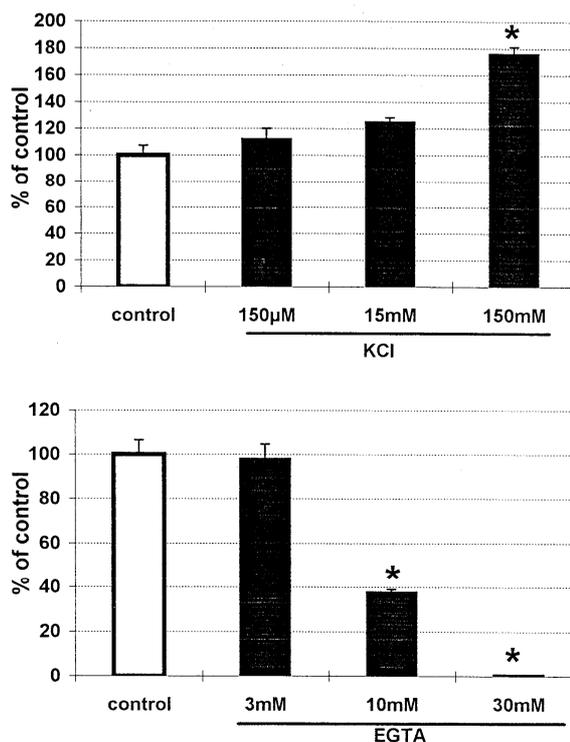
### 3.1 Analysis of 5-HT Signal in PRP

The use of Nafion-mCFE has permitted the selective analysis of 5-HT oxidation signal in PRP. This has been at first demonstrated by the good linearity in current levels monitored when progressive concentrations of ex-

ogenous serotonin were added to PRP. It was also supported by the absence of electrical response following the addition of possible interfering substances that can oxidize at the specific oxidation potential of 5-HT such as uric acid and 5-OH-indoleacetic acid [43-45] (data not shown). It appeared that basal levels of 5-HT in the PRP of Wistar and Sprague-Dawley CD rats were similar: approximately  $0.27 \pm 0.05$ nA and  $0.22 \pm 0.06$ nA, respectively. In addition, in both strains, the 5-HT signal monitored in PRP was progressively increased in the three KCl solutions, whilst it was reduced in a dose-dependent manner until disappearance in the three EGTA solutions (see **Figure 1**).

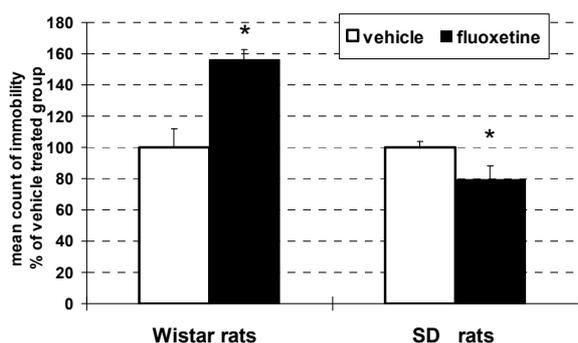
### 3.2 FST and Fluoxetine

When submitted to modified FST, significantly larger counts of immobility were monitored in the pre-test day and test day for Wistar rats versus Sprague-Dawley rats, *i.e.* 37.5 and 47.0 counts versus 25.3 and 38.7 counts, respectively.



**Figure 1.** DPV analysis of 5-HT levels monitored with Nafion-mCFE in PRP incubated in KCl (TOP, n = 4 samples each concentration) or in EGTA (BOTTOM, n = 4 samples each concentration) during 10 min at room temperature. Data are expressed as percent of control values obtained in PRP maintained in PBS during 10 min at room temperature. (n = 4 samples). Mean  $\pm$  sem, \*  $p < 0.05$

Furthermore, in male Wistar rats pre-treated with fluoxetine (20 mg/kg i.p.), behavioral observations indicated a significant increase of immobility up to 156.3% of control when submitted to FST in deeper water (30 cm). In contrast, male Sprague-Dawley CD rats treated with fluoxetine (20 mg/kg i.p.) and then submitted to FST did show a significant decrease of the immobility behavior to 79.4% of control (**Figure 2**). The two ways ANOVA test revealed significant effect of strain and treatment versus strain interaction (see **Table 1**).



**Figure 2.** Effect of acute treatment with fluoxetine (■ 20 mg/kg i.p.) on immobility behavior in Wistar rats or Sprague-Dawley CD (SD) rats (n = 6 each strain) submitted to FST. Data are expressed as % of control values obtained in vehicle treated rats (□ saline, 2 ml/kg i.p., n = 5). Mean ± sem, \* p < 0.05

**Table 1.** Results of the two ways ANOVA test

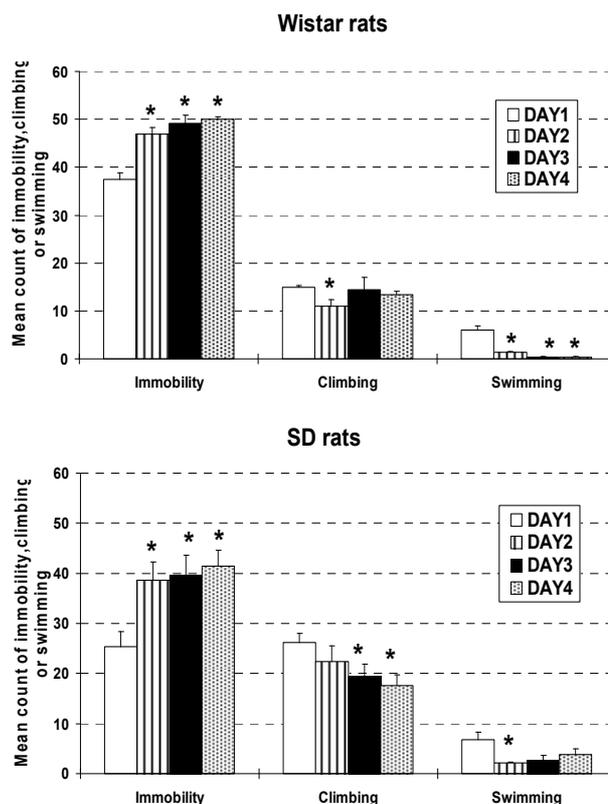
	Factor	F-value	p-value
<b>FST &amp; Fluoxetine</b>			
<b>Immobility</b>	Treatment	1.02	0.32
	Strain	5.40	0.033
	Treatment vs. strain	18.8	0.0004
<b>rFS</b>			
<b>Immobility</b>	Treatment	9.83	0.0001
	Strain	26.5	0.0001
	Treatment vs. strain	0.11	0.95
<b>Climbing</b>	Treatment	2.41	0.085
	Strain	31.5	0.0001
	Treatment vs. strain	1.91	0.15
<b>Swimming</b>	Treatment	15.24	0.0001
	Strain	9.46	0.0043
	Treatment vs. strain	1.11	0.36
<b>Voltammetry after rFS</b>			
<b>5-HT levels in PRP</b>	Treatment	15.38	0.0001
	Strain	7.06	0.012
	Treatment vs. strain	3.62	0.024

### 3.3 rFS

rFS has been performed during four days, including the first day pre-test. The counts of the three types of behavior analyzed (immobility, climbing, swimming) were taken in the first 5 min of the pre-test day and in the 5 min test of the successive three days. They revealed a similar trend of immobility in the two strains of rats; in particular Wistar rats displayed significantly (p < 0.05) greater rate of immobility than Sprague-Dawley CD rats: approx. 46.8 counts *versus* 38.2 counts, respectively (**Figure 3**). On the other hand, the two active behaviors climbing and swimming displayed different patterns in the two species of rats:

1) In Wistar rats, a significant decrease (p < 0.05) of the counts of climbing behavior was observed on the second day only; in the third and the fourth day the counts were similar to those of first day (**Figure 3**);

2) In Sprague-Dawley rats climbing behavior decreased significantly the third and fourth day (17.6 counts) *versus* the first day (26.2 counts) (**Figure 3**).



**Figure 3.** Counts of immobility, climbing and swimming behaviors sampled every 5 sec during the first 5 min of pre-test day (day 1) and during the 5 min of the rFS (days 2-4) estimated in Wistar rats (TOP) or Sprague-Dawley CD (SD) rats (BOTTOM) (n = 5 each strain). Mean ± sem, \* p < 0.05

Data obtained evaluating swimming in Wistar rats showed a rapid significant decrease of this behavior that was virtually disappeared during the third and fourth day of rFS. In Sprague-Dawley rats swimming behavior presented a significant decrease at the second day *versus* the first day, but at the third and fourth day of rFS the swimming behavior returned to values not significantly different from those of the first day (**Figure 3**). The results of the two ways ANOVA test revealed significant main effects of treatment and strain in all behaviors apart from climbing where p value for treatment was 0.08 (**Table 1**).

### 3.4 Voltammetry after rFS

In both strains, 5-HT levels were electrochemically monitored within 200  $\mu$ l of PRP, daily.

The voltammetric results obtained in Wistar rats showed the 5-HT levels monitored in PRP decreased progressively; the third day of rFS they were significantly reduced to 71% of control values recorded in PRP of naïve rats. In contrast, in Sprague-Dawley rats, PRP-5-HT levels showed a significant increase at the first day of rFS while returning to values similar to those of control naïve rats the second and third day of the experiment (**Figure 4**). The results of the two ways ANOVA test revealed significant main effects of strain, treatment and strain by treatment interaction (see **Table 1**). In addition, significant correlation between swimming scores and 5-HT levels in PRP of the Wistar rats only has been determined:  $r = 0.53$ ,  $p = 0.015$ .

## 4. Discussion

FST is described in the literature as a “behavioral despair” test [1,3,4] as it produces a change in behavior *i.e.* an immobile posture that is considered “a key symptom of the depressive state, namely that of despair or helplessness” [3]. On the other hand it has been also suggested that the resulting behavior following FST could be due to the possibility that “the subject learns to be immobile” in the first session, being the second one a “retention test” (learned immobility hypothesis) [18,21,22]. Furthermore, it is described that Wistar rats display less mobility than Sprague-Dawley CD rats when submitted to FST [11]. From these data one could hypothesize either that:

1) Wistar rats are more sensitive to stress than Sprague-Dawley CD rats and so their greater immobility could be correlated to a “behavioral despair”; or that:

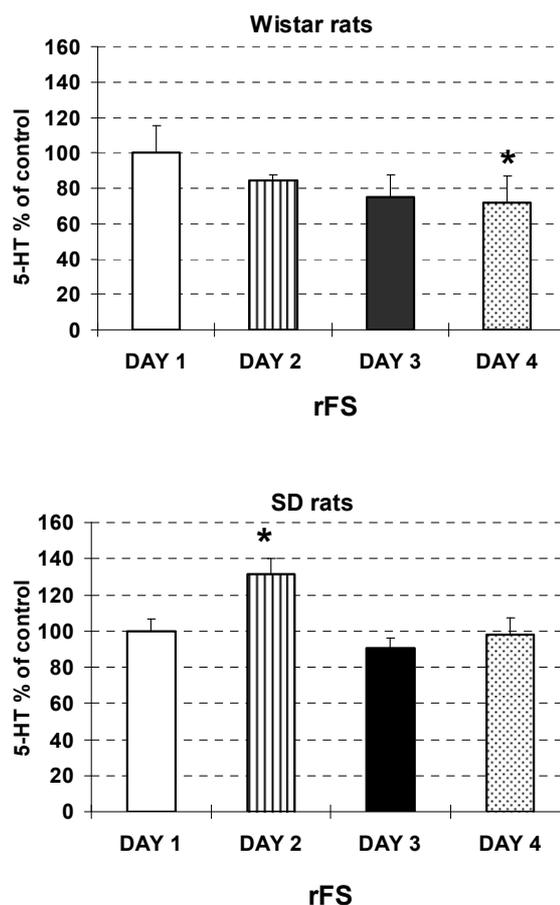
2) Wistar rats display a greater memory and learning skills than Sprague-Dawley CD rats.

Therefore, in this study the hypothesis that the process involved in the FST could be “learning to be immobile” more than “behavioral despair” has been investigated in

Wistar rats and in Sprague-Dawley CD rats. Putative differences in behavior during FST or rFS (4 days) and the effect(s) of fluoxetine (SSRI) upon responses to FST were analyzed in these two strains.

At first we have confirmed data from the literature showing larger counts of immobility in Wistar rats *versus* Sprague-Dawley CD rats when submitted to FST (see **Figure 3**). Successively, a modified version of FST, so called rFS [15-17] has been applied so that putative differences in behavioral responses between Sprague-Dawley CD rats and Wistar rats could be evaluated.

Data show a significant increase of immobility in both strains within the second day of the rFS test and continuing the third and the fourth day of rFS in both types of rats (see **Figure 3**). Because of the numerous factors influencing the FST test, it has been suggested that the time



**Figure 4.** Influence of rFS upon DP voltammetric 5-HT levels monitored in PRP prepared from blood collected daily at the end of each FS session from tail vein of Wistar ( $n = 5$ ) or Sprague-Dawley CD ( $n = 5$ ) rats. Data are expressed as percent of control values obtained by measuring 5-HT levels in PRP prepared from blood of five naïve rats. Mean  $\pm$  sem, \*  $p < 0.05$

of immobility on the second day of rFS might be considered a nonspecific parameter referred to as “learning to be immobile” rather than “behavioral despair” [21]. The present data also show that treatment with fluoxetine actually increases immobility as well. Since fluoxetine is a compound that inhibits serotonin reuptake, thus making it more available at its receptors, this result could appear like a contradiction, however in the Porsolt’ test the SSRIs have been found to be ineffective or even prolonging the time of immobility [6,46]. Similarly, while in the literature, the results concerning the ineffectiveness of the SSRIs in rats are still controversial, it has been constantly reported that the SSRIs extend the time of immobility in mice [46]. It is also well known that acute treatment with SSRIs may produce anxiogenic-like effects in humans [47] as well as in animals [48]. Furthermore, Borsini *et al.* [49] have indirectly illustrated that the emotional state of an animal might be important for the outcome of the test. Accordingly, our data show that Wistar rats display greater immobility and that is in agreement to the reported observation that such an inbred rat strain is inclined to higher behavioral and physiological responses to stress across a variety of situations in comparison to other strains [15]. This would also explain the significant decrease of swimming mainly observable in Wistar rats.

#### 4.1 Voltammetry in PRP

Concomitant *in vivo* DPV voltammetric analysis performed accordingly with Zen *et al.* [32] has shown that the signal monitored with Nafion-mCFE in PRP at the oxidation potential of 5-HT was selectively sensitive to addition of exogenous 5-HT (data not shown). Furthermore, experiments performed in PRP accordingly with Barja-Fidalgo *et al.* [50] have shown that incubation in KCl stimulates increase of the 5-HT related DPV signal. Finally, accordingly with Lyons and Shaw [51] treatment of PRP with the calcium-chelating agent EGTA has demonstrated a dose dependent reduction of the 5-HT related signal (see **Figure 1**). Thus, these DPV voltammetric data support the chemical nature of the signal monitored in PRP as corresponding to the oxidation of basal, endogenous 5-HT level in PRP. Successively, DPV measurements performed during the behavioral tests showed that 5-HT level in PRP decreased progressively in Wistar rats submitted to rFS, while they increased at day 1 of rFS in Sprague-Dawley rats and returned to control levels the next days. The fact that “peripheral” 5-HT levels [in PRP] mirror central 5-HT levels has been already documented [23-27]. Therefore the present data on 5-HT level in PRP of Wistar rats taken together with the observation that pharmacological blockade of serotonergic activity enhance learning and memory skills [19,20] may suggest that the increased immobility fol-

lowing rFS monitored in Wistar rats could be due to “learning to be immobile” more than “behavioral despair”. Thus, the concomitant decrease of 5-HT levels monitored in PRP and considered as peripheral marker of modifications of central 5-HT system may be correlated to the enhancement of learning skill; *i.e.* it could lead Wistar rats to develop habituation to be immobile when submitted to rFS. Conversely, other authors have reported that serotonin receptor agonists deteriorate such skills [52,53], therefore the hypothesis proposed above is still matter of discussion. When related to the same observation reported above [19,20] the significant increase of 5-HT level in PRP of Sprague-Dawley CD rats leads one to consider that in this strain of rats the significant increase of immobility following rFS could be unrelated to “learning to be immobile” but may be interpreted in the light of a “behavioral despair” hypothesis. However, this conclusion is in disaccord with the finding that (diet) tryptophan restriction, and therefore brain serotonin reduction, could impair normal cholinergic activity in some brain areas such as the hippocampus and the cerebral cortex that are involved in learning and memory processes [54]. These observations lead to the comment that work remains to be done to further elucidate the contrasting data present in literature on this matter. Decreased levels of central 5-HT has been recently reported in Wistar rats submitted to rFS [55]. Our voltammetric data on 5-HT levels monitored in PRP of Wistar rats match these recent findings which therefore support the proposal that peripheral 5-HT levels monitored by means of DPV together with mCFE in rat PRP mirror cerebral 5-HT contents.

Furthermore and on the basis of the 5-HT hypothesis of depression suggesting a relationship between vulnerability to this illness and a deficit in the brain serotonergic activity [56] the depletion of 5-HT caused by forced swimming may be one of the reasons for the development of depressive-like behavior in Wistar rats.

On the other hand, the observation of an increased level of 5-HT on day 2 returning to ‘control’ values on days 3 and 4 in the PRP of Sprague-Dawley CD rats lead one to propose that there is not such a central 5-HT deficit in this second strain of rats. This is supporting the idea that rFS may display learning behavior in Sprague-Dawley CD rats as the present results suggest that experience and learning may be the principal processes at the basis of the significant increase of immobility in Sprague-Dawley CD. Indeed, in these rats, immobility levels were continuously increasing during the 3 days of rFS following the pre-test day (day 1, see **Figure 3**), without reaching a plateau while showing higher variability on their response when compared to that of Wistar rats (see **Figure 3**). In contrast, the Wistar rats submitted to rFS present less mobility than the Sprague-Dawley CD

rats; *i.e.* they show less variability on their response (see **Figure 3** top) and reach a stable (plateau) level of immobility the third and fourth day of the test. Thus, “behavioral despair” seems to be the cause of the increased immobility in Wistar rats as their “answer” to the recurring stress produced by the repetition of the test is the ‘sudden’ increased immobility to a plateau as indeed found at the third and fourth day of rFS. Accordingly with previous studies indicating that various stressors alter 5-HT synthesis / turnover [57,58], the different behavior within these two strains may therefore also be related to the different biochemical “reaction” of their 5-HT central system when submitted to FST: *i.e.* progressive decrease of 5-HT levels in Wistar rats versus a significant increase in day 1 followed by return to control values days 2 and 3 in Sprague-Dawley CD rats (**Figure 4**).

The present study also shows a rapid decrease of swimming until virtually its disappearance during the third-fourth day of rFS in Wistar rats. In contrast, in Sprague-Dawley rats swimming behavior presented a significant decrease at the second day *versus* the first testing day, but at the third and fourth day it returned to values not significantly different from those recorded in the first day of rFS. Again, this difference in swimming behavior between the two strains of rats could be related to the difference in 5-HT levels monitored after each swimming session in PRP of both species of rats. In Wistar rats 5-HT levels monitored in PRP decreased progressively; reaching the minimum significant value at the third day of rFS. In Sprague-Dawley rats, 5-HT levels in PRP showed a significant increase at the first day of rFS, returning to values similar to those of control rats the following days of experiment. This is in accord with the relationship described in literature between serotonergic system activities and swimming behavior during FST: in particular an enhancement of 5-HT neurotransmission mediates positively the swimming behavior of Sprague-Dawley CD rats [4,6].

Moreover, it is interesting to note the different climbing behavior displayed by the two rat strains when submitted to rFS:

- 1) Progressive decrease of climbing in Sprague-Dawley CD rats;
- 2) Initial decrease followed by a return to the values of day 1 in Wistar rats.

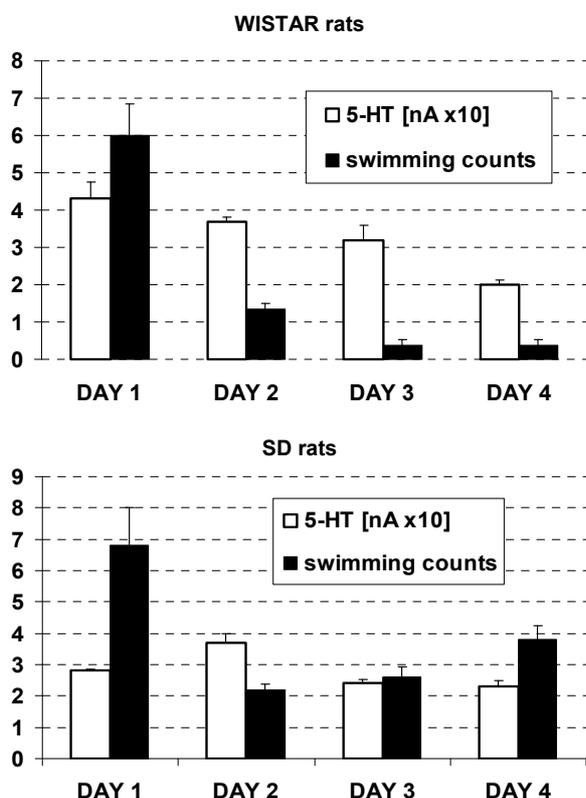
Therefore, when submitted to rFS, these two strains of rats display opposite swimming and climbing behaviors (see **Figure 3**). Briefly:

- 1) In Wistar rats climbing at first decreased [day 2] then restored the levels of day1 while swimming decreased progressively;
- 2) In Sprague-Dawley CD rats climbing decreased progressively while swimming at first decreased [day 2] then tended to return to the initial levels.

It is reported that climbing is a behavior mediated by

noradrenergic neurotransmission and swimming a behavior mediated by serotonergic neurotransmission [4,6]. Thus, one can argue that the behavioral data monitored here, could be an index of distinct activities of the two neurotransmitter systems within the two strains of rats when submitted to FST as well as to rFS. In particular, the dissimilarity observed within the serotonergic system of the two strains *i.e.* when submitted to rFS may account for the different behavioral response to fluoxetine treatment observed here *i.e.* either increase or reduction of immobility in Wistar rats or in Sprague-Dawley CD rats, respectively (see **Figure 2**). Accordingly, the data concerning swimming counts led one to argue about the additional presence of a divergent activity of the noradrenergic system in the two rat strains during FST or rFS. Further studies should be done to analyze this point. Yet, it is interesting to note the parallel, significantly related decrease of swimming counts and 5-HT levels monitored in PRP of the Wistar rats submitted to rFS (see **Figure 5**). Taken together with the findings that reductions of noradrenaline or 5-HT, which do not by themselves impair place learning, aggravate the place-learning deficit produced by reductions of Ach [59] the present data support the idea that in Wistar rats the increased immobility following rFS could be due to “behavioral despair” more than “learning to be immobile”. On the contrary, the lack of change on 5-HT levels as well as in swimming behavior observed in the Sprague-Dawley CD rats may suggest that the increased immobility following rFS could be due to “learning to be immobile” more than “behavioral despair”.

Differential sensitivity to the behavioral effects of fluoxetine by different rat strains has been already reported. In particular it has been shown that genetic or constitutive differences may determine the distinct behavioral profiles for antidepressant compounds with selective pharmacological effects in different rat strains such as male Sprague Dawley and Wistar Kyoto rats [11, 60]. The latter is a line derived from Wistar rats, presenting significant higher plasma levels of corticosterone and ACTH compared to Wistar rats that are the “control line” of the Wistar Kyoto rats [61]. On the other hand, these authors have also shown that Wistar rats exhibited significantly longer immobility duration in the swim test compared with the Sprague-Dawley CD rats. This is in accord with the present observation of a significantly higher counts of immobility in Wistar rats versus Sprague-Dawley CD rats submitted to rFS (see **Figure 3** and **Table 1**). Altogether such results suggest that different rat strains may demonstrate great variability in the behavioral response to antidepressants according to their genetic or constitutive differences as well as pharmacological selectivity, differences that should be not ruled out



**Figure 5.** Influence of rFS upon swimming and DPV voltammetric 5-HT levels monitored in PRP prepared from blood collected daily at the end of each FS from tail vein of Wistar rats ( $n = 5$ ) or Sprague-Dawley CD rats ( $n = 5$ ). Mean counts ( $\pm$  sem) are shown together with 5-HT levels (*i.e.* nanoAmperes [nA] multiplied by 10 for graphic purpose). Significant correlation between swimming scores and 5-HT levels in PRP of Wistar rats has been determined:  $r = 0.53$ ,  $p = 0.015$

when evaluating behavioral and neurochemical changes in response to antidepressants such as fluoxetine. In this sense, it is worth mentioning that it has recently been shown that four 5-HT receptor systems (5-HT<sub>1A</sub>, 5-HT<sub>2A</sub>, 5-HT<sub>4</sub>, 5-HT<sub>6</sub>) are highlighted as suitable targets for enhancing cognition and memory (for a review see [62]) with in particular the 5-HT<sub>6</sub> receptor playing a role in learning and memory processes in healthy and disease states (see reviews by Mitchell and Neumaier [63] and Schreiber *et al.* [64]). The putative synergistic interaction of 5-HT<sub>6</sub> receptors with other serotonin receptors is also shown to be important for memory processes [65]. Therefore, differences in such aspects within the different strains of rats may also account for the variability in behavioral responses.

## 5. Conclusions

In conclusion, the present *in vivo* electrochemical analysis support our previous work showing that peripheral

5-HT levels selectively monitored in rat PRP by means of DPV together with Nafion-mCFE mirror cerebral 5-HT contents [28]. In particular it allows deducing changes of central 5-HT levels that could be correlated to behavioral tests such as FST or rFS. Therefore, this *in vivo* approach displays the clear advantage of non invasive behavioral-pharmacological analysis of neurotransmitter activities in conscious animals. Finally, while further work is needed to support the following idea, the combined behavioral-pharmacological data presented suggest that “learning to be immobile” seems to be the process involved in Sprague-Dawley CD rats submitted to rFS while “behavioral despair” seems to be the process involved in Wistar rats submitted to rFS.

## 6. Acknowledgements

For technical support to Dr. E. Vecchiato and Dr. C. Lazzarini.

## REFERENCES

- [1] R. D. Porsolt, M. Le Pichon and M. Jalfre, “Depression: A New Animal Model Sensitive to Anti Depressant Treatments,” *Nature*, Vol. 266, No. 5604, 1977, pp. 730-732.
- [2] F. Borsini and A. Meli, “Is the Forced Swimming Test a Suitable Model for Revealing Antidepressant Activity?” *Psychopharmacology*, Vol. 94, No. 2, 1988, pp. 147-160.
- [3] T. J. Connor, P. Kelliher, Y. Shen, A. Harkin, J. P. Kelly and B. E. Leonard, “Effect of Subchronic Antidepressant Treatments on Behavioral, Neurochemical, and Endocrine Changes in the Forced-Swim Test,” *Pharmacology Biochemistry and Behavior*, Vol. 65, No. 4, 2000, pp. 591-597.
- [4] M. J. Detke and I. Lucki, “Detection of Serotonergic and Noradrenergic Antidepressants in the Rat Forced Swimming Test: The Effect of Water Depth,” *Behavioural Brain Research*, Vol. 73, No. 1-2, 1996, pp. 43-46.
- [5] R. D. Porsolt, A. Bertin, N. Blavet, M. Deniel and M. Jalfre, “Immobility Induced by Forced Swimming in Rats: Effects of Agents which Modify Central Catecholamine and Serotonin Activity,” *European Journal of Pharmacology*, Vol. 57, No. 2-3, 1979, pp. 201-210.
- [6] M. J. Detke, M. Rickels and I. Lucki, “Active Behaviors in the Rat Forced Swimming Test Differentially Produced by Serotonergic and Noradrenergic Antidepressants,” *Psychopharmacology*, Vol. 121, No. 1, 1995, pp. 66-72.
- [7] S. E. Hemby, I. Lucki, G. Gatto, A. Singh, C. Thornley, J. Matasi, N. Kong, J. E. Smith, H. M. L. Davies and S. I. Dworkin, “Potential Antidepressant Effects of Novel Tropane Compounds, Selective for Serotonin or Dopamine Transporters,” *Journal of Pharmacology and Experimental Therapeutics*, Vol. 282, No. 2, 1997, pp. 727-733.
- [8] L. G. Kirby and I. Lucki, “Interaction between the Forced Swimming Test and Fluoxetine Treatment on Extracellular 5-Hydroxytryptamine and 5-Hydroxyindoleacetic Acid in the Rat,” *Journal of Pharmacology and Experimental Therapeutics*, Vol. 282, No. 2, 1997, pp. 967-976.

- [9] M. E. Page, M. J. Detke, G. Kirby and I. Lucki, "Serotonergic Mediation of the Effects of Fluoxetine, but not Desipramine, in the Rat Forced Swimming Test," *Psychopharmacology*, Vol. 147, No. 2, 1999, pp. 162-167.
- [10] J. P. Reneric and I. Lucki, "Antidepressant Behavioral Effects by Dual Inhibition of Monoamine Reuptake in the Rat Forced Swimming Test," *Psychopharmacology*, Vol. 136, No. 2, 1998, pp. 190-197.
- [11] C. López-Rubalcava and I. Lucki, "Strain Differences in the Behavioral Effects of Antidepressant Drugs in the Rat Forced Swimming Test," *Neuropsychopharmacology*, Vol. 22, No. 2, 2000, pp. 191-199.
- [12] T. Skrebuhhova, L. Allikmets and V. Matto, "Effect of Anxiogenic Drugs in Rat Forced Swimming Test," *Methods & Findings in Experimental & Clinical Pharmacology*, Vol. 21, No. 3, 1999, pp. 173-178.
- [13] J. De Vry, S. Maurel, R. Schreiber, R. de Beun and K. R. Jentsch, "Comparison of Hypericum Extracts with Imipramine and Fluoxetine in Animal Models of Depression and Alcoholism," *European Neuropsychopharmacology*, Vol. 9, No. 6, 1999, pp. 461-468.
- [14] G. Griebel, C. Cohen, G. Perrault and D. J. Sanger, "Behavioral Effects of Acute and Chronic Fluoxetine in Wistar-Kyoto Rats," *Physiology & Behavior*, Vol. 67, No. 3, 1999, pp. 315-320.
- [15] J. F. Cryan, M. E. Page and I. Lucki, "Differential Behavioral Effects of the Antidepressants Reboxetine, Fluoxetine, and Moclobemide in a Modified Forced Swim Test Following Chronic Treatment," *Psychopharmacology (Berl)*, Vol. 182, No. 3, 2005, pp. 335-339.
- [16] S. Dal-Zotto, O. Marti and A. Armario, "Influence of Single or Repeated Experience of Rats with Forced Swimming on Behavioral and Physiological Responses to the Stressor," *Behavioural Brain Research*, Vol. 114, No. 1-2, 2000, pp. 175-181.
- [17] L. G. Kirby and I. Lucki, "The Effect of Repeated Exposure to Forced Swimming on Extracellular Levels of 5-Hydroxytryptamine in the Rat," *Stress*, Vol. 2, No. 4, 1998, pp. 251-263.
- [18] A. Parra, C. Vinader-Caerols, S. Monleón and V. M. Simón, "Learned Immobility is also Involved in Forced Swimming Test in Mice," *Psicothema*, Vol. 11, No. 2, 1999, pp. 239-246.
- [19] Y. Lamberty and A. J. Gower, "Cholinergic Modulation of Spatial Learning in Mice in a Morris-Type Water Maze," *Archives Internationales de Pharmacodynamie et de Therapie*, Vol. 309, 1991, pp. 5-19.
- [20] G. Richter-Levin and M. Segal, "The Effect of Serotonin Depletion and Raphe Grafts on Hippocampal Electrophysiology and Behavior," *Journal of Neuroscience*, Vol. 11, No. 6, 1991, pp. 1585-1596.
- [21] J. M. de Pablo, A. Parra, S. Segovia and A. Guillamon, "Learned Immobility Explains the Behavior of Rats in the Forced Swimming Test," *Physiology & Behavior*, Vol. 46, No. 2, 1989, pp. 229-237.
- [22] A. J. Martos, C. Vinader-Caerols, S. Monleón, M. C. Arenas and A. Parra, "Effect of Physostigmine and Nicotine on Learned Immobility in the Forced Swimming Test," *Psicothema*, Vol. 11, No. 3, 1999, pp. 631-639.
- [23] E. H. Cook, K. E. Fletcher, M. Wainwright, N. Marks, S. Y. Yan and B. L. Leventhal, "Primary Structure of the Human Platelet Serotonin 5-HT<sub>2A</sub> Receptor: Identity with Frontal Cortex Serotonin 5-HT<sub>2A</sub> Receptor," *Journal of Neurochemistry*, Vol. 63, No. 2, 1994, pp. 465-469.
- [24] C. R. Pfeffer, P. A. McBride, G. M. Anderson, T. Kakuma, L. Fensterheim and V. Khait, "Peripheral Serotonin Measures in Prepubertal Psychiatric Inpatients and Normal Children: Association with Suicidal Behavior and its Risk Factors," *Biological Psychiatry*, Vol. 44, No. 7, 1988, pp. 568-577.
- [25] S. D. Mendelson, "The Current Status of the Platelet 5-HT<sub>2A</sub> Receptor in Depression," *Journal of Affective Disorders*, Vol. 57, No. 1, 2000, pp. 13-24.
- [26] J. M. Sneddon, "Blood Platelets as a Model for Monoamine Containing Neurones," *Progress in Neurobiology*, Vol. 1, No. 2, 1973, pp. 151-198.
- [27] S. M. Stahl, "The Human Blood Platelet: A Diagnostic and Research Tool for the Study of Biogenic Amines in Psychiatric and Neurologic Disorders," *Archives of General Psychiatry*, Vol. 34, No. 5, 1977, pp. 509-516.
- [28] M. Bianchi, C. Moser, C. Lazzarini, E. Vecchiato and F. Crespi, "Forced Swimming Test and Fluoxetine Treatment: In Vivo Evidence that Peripheral 5-HT in Rat Platelet-Rich Plasma Mirrors Cerebral Extracellular 5-HT Levels, whilst 5-HT in Isolated Platelets Mirrors Neuronal 5-HT Changes," *Experimental Brain Research*, Vol. 143, No. 2, 2002, pp. 191-197.
- [29] F. Congestri, F. Formenti, V. Sonntag and F. Crespi, "The Selective D3 Receptor Antagonist SB-277011-A Potentiates the Effect of Cocaine on Extracellular Dopamine in the Nucleus Accumbens: A Dual Core-Shell Voltammetry Study in Anesthetized Rats," *Sensors*, Vol. 8, No. 11, 2008, pp. 6936-6951.
- [30] F. Crespi, "In Vivo Voltammetry with Micro-Biosensors for Analysis of Neurotransmitter Release and Metabolism," *Journal of Neuroscience Methods*, Vol. 34, No. 1-3, 1990, pp. 53-65.
- [31] F. Crespi, K. F. Martin and C. A. Marsden, "Measurement of Extracellular Basal Levels of Serotonin in Vivo Using Nafion-Coated Carbon Fibre Electrodes Combined with Differential Pulse Voltammetry," *Neuroscience*, Vol. 27, No. 3, 1988, pp. 885-896.
- [32] J.-M. Zen, I.-L. Chen and Y. Shih, "Voltammetric Determination of Serotonin in Human Blood Using a Chemically Modified Electrode," *Analytica Chimica Acta*, Vol. 369, No. 1-2, 1998, pp. 103-108.
- [33] F. Crespi, "In Vivo Voltammetry and Concomitant Electrophysiology at a Single Biosensor to Analyse Ischaemia, Depression and Drug Dependence," *Journal of Neuroscience Methods*, Vol. 119, No. 2, 2002, pp. 173-184.
- [34] F. Crespi and M. Jouvet, "Differential Pulse Voltammetry: Parallel Peak 3 Changes with Vigilance States in Raphe

- Dorsalis and Raphe Magnus of Chronic Freely Moving Rats and Evidence for 5HT Contribution to this Peak after Monoamine Oxidase Inhibitors," *Brain Research*, Vol. 272, No. 2, 1983, pp. 263-268.
- [35] A. Louilot, A. Serrano and M. D'Angio, "A Novel Carbon Fiber Implantation Assembly for Cerebral Voltammetric Measurements in Freely Moving Rats," *Physiology & Behavior*, Vol. 41, No. 3, 1987, pp. 227-231.
- [36] S. L. Handley and J. W. McBlane, "Opposite Effects of Fluoxetine in Two Animal Models of Anxiety," *British Journal of Pharmacology*, Vol. 107S, 1997, p. 446.
- [37] M. L. Rao, B. Hawellek, A. Papassotiropoulos, A. Deister and C. Frahnert, "Upregulation of the Platelet Serotonin<sub>2A</sub> Receptor and Low Blood Serotonin in Suicidal Psychiatric Patients," *Neuropsychobiology*, Vol. 38, No. 2, 1998, pp. 84-89.
- [38] F. Crespi, "Apamin Increases 5-HT Cell Firing in Raphe Dorsalis and Extracellular 5-HT Levels in Amygdala: A Concomitant in Vivo Study in Anesthetized Rats," *Brain Research*, Vol. 1281, 2009, pp. 35-46.
- [39] K. F. Martin, C. A. Marsden and F. Crespi. "In Vivo Electrochemistry with Carbon Fibre Electrodes: Principles and Application to Neuropharmacology," *Trends in Analytical Chemistry*, Vol. 7, No. 9, 1988, pp. 334-339.
- [40] J. A. Stamford, F. Crespi and C. A. Marsden, "In Vivo Voltammetric Methods for Monitoring Monoamine Release and Metabolism," *Monitoring Neuronal Activity, a Practical Approach*, Oxford University Press, Oxford, 1992, pp. 113-145.
- [41] T. Self and F. Crespi, "Electron Microscopic and Voltammetric Analysis of Carbon Fibre Electrode Pretreatments," *Journal of Materials Science: Materials in Medicine*, Vol. 3, No. 6, 1992, pp. 418-425.
- [42] F. Crespi and Z. L. Rossetti, "Pulse of Nitric Oxide Release in Response to Activation of N-Methyl-D-Aspartate Receptors in the Rat Striatum: Rapid Desensitisation, Inhibition by Receptor Antagonists and Potentiation by Glycine," *Journal of Pharmacology and Experimental Therapeutics*, Vol. 309, No. 2, 2004, pp. 462-468.
- [43] F. Crespi, T. Sharp, N. Maidment and C. A. Marsden, "Differential Pulse Voltammetry in Vivo—Evidence that Uric Acid Contributes to the Indole Oxidation Peak," *Neuroscience Letters*, Vol. 43, No. 2-3, 1983, pp. 203-207.
- [44] F. Crespi, T. Sharp, N. Maidment and C. A. Marsden, "Differential Pulse Voltammetry: Simultaneous in Vivo Measurement of Ascorbic Acid, Catechols and 5-Hydroxyindoles in the Rat Striatum Using a Single Carbon Fibre Electrode," *Brain Research*, Vol. 322, No. 1, 1984, pp. 135-138.
- [45] F. Crespi, P. Keane and M. Morre, "Does Concomitant Analysis of Extracellular DOPAC and 5HIAA with a Single Carbon Fibre Electrode Enable the Detection of Striatal Dopamine-Serotonin Interaction?" *Journal of Neurochemistry*, 1985, Vol. 44, pp. 109-112.
- [46] F. Borsini, "Role of the Serotonergic System in the Forced Swimming Test," *Neuroscience & Biobehavioral Reviews*, Vol. 19, No. 3, 1995, pp. 377-395.
- [47] W. F. Boyer and J. P. Feighner, "Side Effects of the Selective Serotonin Re-Uptake Inhibitors," In: J. P. Feighner and W. F. Boyer, Ed., *Selective Serotonin Re-Uptake Inhibitors. Perspectives in Psychiatry 1*, Wiley Press, New York, 1991, pp. 133-152.
- [48] P. Chopin and M. Briley, "Animal Models of Anxiety: The Effect of Compounds that Modify 5-HT Neurotransmission," *Trends in Pharmacological Sciences*, Vol. 8, No. 10, 1987, pp. 383-388.
- [49] F. Borsini, A. Lecci, A. Sessarego, R. Frassine and A. Meli, "Discovery of Antidepressant Activity by Forced Swimming Test may Depend on Pre-Exposure of Rats to a Stressful Situation," *Psychopharmacology*, Vol. 97, No. 2, 1989, pp. 183-188.
- [50] C. Barja-Fidalgo, J. A. Guimaraes and C. R. Carlini, "The Secretory Effect of Canatoxin on Rat Brain Synaptosomes Involves A Lipoygenase-Mediated Pathway," *Brazilian Journal of Medical and Biological Research*, Vol. 21, No. 3, 1988, pp. 549-552.
- [51] R. M. Lyons and J. O. Shaw, "Interaction of Ca<sup>2+</sup> and Protein Phosphorylation in the Rabbit Platelet Release Reaction," *Journal of Clinical Investigation*, Vol. 65, No. 2, 1980, pp. 242-255.
- [52] H. C. Buhot, S. Martin and L. Segu, "Role of Serotonin in Memory Impairment," *Annals of Medicine*, Vol. 32, No. 3, 2000, pp. 210-221.
- [53] W. J. McEntee and T. H. Crook, "Serotonin, Memory, and the Aging Brain," *Psychopharmacology*, Vol. 103, No. 2, 1991, pp. 143-149.
- [54] I. Gonzalez-Burgos, M. I. Perez-Vega, A. R. Del Angel-Meza and A. Feria-Velasco, "Effect of Tryptophan Restriction on Short-Term Memory," *Physiology & Behavior*, Vol. 63, No. 2, 1998, pp. 165-169.
- [55] G. T. Shishkina, T. S. Kalinina and N. N. Dygalo, "Serotonergic Changes Produced by Repeated Exposure to Forced Swimming: Correlation with Behavior," *Annals of the New York Academy of Sciences*, Vol. 1148, 2008, pp. 148-153.
- [56] M. H. Maes and Y. Meltzer, "The Serotonin Hypothesis of Major Depression," In: F. E. Bloom and D. J. Kupfer, Ed., *Psychopharmacology: The Fourth Generation of Progress*, Raven Press, New York, 1995, pp. 933-944.
- [57] F. Chaouloff, "Physiopharmacological Interactions between Stress Hormones and Central Serotonergic Systems," *Brain Research Reviews*, Vol. 18, No. 1, 1993, pp. 1-32.
- [58] L. E. Rueter, C. A. Fornal and B. L. Jacobs, "A Critical Review of 5-HT Brain Microdialysis and Behavior," *Reviews in the Neurosciences*, Vol. 8, No. 2, 1997, pp. 117-137.
- [59] R. K. McNamara and R. W. Skelton, "The Neuropharmacological and Neurochemical Basis of Place Learning in the Morris Water Maze," *Brain Research Reviews*, Vol. 18, No. 1, 1993, pp. 33-49.
- [60] S. Tejani-Butt, J. Kluczynski and W. P. Paré, "Strain-Dependent Modification of Behavior Following Antide-

- pressant Treatment,” *Progress in Neuro-Psychopharmacology & Biological Psychiatry*, Vol. 27, No. 1, 2003, pp. 7-14.
- [61] O. Malkesman, Y. Braw, R. Maayan, A. Weizman, D. H. Overstreet, M. Shabat-Simon, Y. Kesner, *et al.*, “Two Different Putative Genetic Animal Models of Childhood Depression,” *Biological Psychiatry*, Vol. 59, No. 1, 2006, pp. 17-23.
- [62] B. L. Roth, S. M. Hanizavareh and A. E. Blum, “Serotonin Receptors Represent Highly Favorable Molecular Targets for Cognitive Enhancement in Schizophrenia and Other Disorders,” *Psychopharmacology*, Vol. 174, No. 1, 2004, pp. 17-24.
- [63] E. S. Mitchell and J. F. Neumaier, “5-HT<sub>6</sub> Receptors: A Novel Target for Cognitive Enhancement,” *Pharmacology & Therapeutics*, Vol. 108, No. 3, 2005, pp. 320-333.
- [64] R. Schreiber, A. J. Sleight and M. L. Woolley, “5-HT<sub>6</sub> Receptors as Targets for the Treatment of Cognitive Deficits in Schizophrenia,” In: B. R. Roth, Ed., *Serotonin Receptors: From Molecular Pharmacology to Human Therapeutics*, Humana Press, Totowa, 2006, pp. 495-515.
- [65] E. S. Mitchell, B. J. Hoplight, S. P. Lear and J. F. Neumaier, “BGC20-761, a Novel Tryptamine Analog, Enhances Memory Consolidation and Reverses Scopamine-Induced Memory Deficit in Social and Visuospatial Memory Tasks through a 5-HT<sub>6</sub> Receptor-Mediated Mechanism,” *Neuropharmacology*, Vol. 50, No. 4, 2006, pp. 412-420.

# Middle Ear Effusion, Attention, and the Development of Child Behavior Problems\*

Jannette Cross<sup>1</sup>, Dale L. Johnson<sup>1</sup>, Paul Swank<sup>2</sup>, Constance D. Baldwin<sup>3</sup>, David McCormick<sup>4</sup>

<sup>1</sup>University of Houston, Houston, USA; <sup>2</sup>University of Texas Medical School, Houston, USA; <sup>3</sup>University of Rochester, Rochester, USA; <sup>4</sup>University of Texas Medical Branch, Galveston, USA.

Email: [dljohnson27@msn.com](mailto:dljohnson27@msn.com)

Received April 7<sup>th</sup>, 2010; revised June 23<sup>rd</sup>, 2010; accepted June 25<sup>th</sup>, 2010.

## ABSTRACT

*Objective: Much interest centers on whether middle ear effusion (MEE) early in life has lasting developmental consequences. It was hypothesized that episodic loss of hearing acuity associated with MEE results in a deficit in attention, a core factor in the development of child behavior problems, and that impaired attention is related to behavior problems during the early years of childhood. Method: This was a prospective study of a large sample of children (n = 698) that was representative of the local population in terms of socioeconomic and ethnic characteristics. The children were recruited at birth and were monitored with regular home visits for 3 years to check for the presence of MEE. Assessment of attention occurred at 2, 3, 5, and 7 years. Behavior problems were assessed at 3, 5, and 7 years. Results: The results did not support the hypothesis that children with greater duration of MEE experience greater attention deficits and more behavior problems than children with a shorter duration of MEE. Structural Equation Modeling parameter estimates resulted in no support for the primary hypothesis. Correlational analyses also did not support the hypothesis. Attention and behavior problems were related significantly. Conclusions: Our negative findings call into question the results of previous studies relating MEE to behavior and attention problems, studies that may have been biased by small, non-representative samples and retrospective designs that lacked careful documentation of MEE.*

**Keywords:** Middle Ear Effusion, Attention, Behavior Problems

## 1. Introduction

Middle ear effusion (MEE), an inflammation of the middle ear accompanied by effusion or a collection of liquid in the middle ear, is one of the most commonly diagnosed illnesses among young children. Estimates of MEE incidence rates in the United States range from 49% to 97% during the first year of life [1]. Incidence peaks between 6 and 18 months with a steady decline until around 5 years, when there is a second smaller peak [1,2]. Almost one-third of all children suffer with chronic MEE and it is estimated that some spend an average of 38% to 70% of their first 3 years with MEE [3]. Most children with MEE have an average hearing loss of 20 to 30 dB [4] during an episode. The conductive hearing loss associated with MEE causes sounds to be muffled and distorted.

The fluctuating hearing loss caused by episodes of

MEE is believed to cause developmental problems, including child behavior problems. Problems in language and speech have been the focus of much research [5,6] and it has also been proposed that attention processes may be effected [7]. It has been hypothesized that frequent episodes of MEE during early childhood produce initial language delays and a reduction in attention-to-language. In the later preschool years, when the number of MEE episodes is reduced and hearing returns to normal, basic language skills recover. However, children with recurrent MEE may not be able to attend to language input consistently and may develop the habit of not attending because of the greater effort required. This, in turn, may lead to an attention deficit for language-related tasks that require sustained attention, a deficit that persists after hearing is normal [8,9]. In addition to effects on language and attention, behavior problems may ensue. Children may withdraw and become less responsive to their environment, or act out because they cannot respond to the positive cues in the environ-

\*This project was supported under award # HD20988 R01, from the National Institute of Child Health and Development, "Impact on Child Development of Early Otitis Media".

ment. Parents and teachers may have more difficulty providing responsive stimulation. They may perceive the child as willfully ignoring them, and change their own interactive behavior accordingly [10].

### 1.1 MEE and Attention

Several prospective studies have found persistent MEE and attention to be linked [7-11]. In a prospective study with a sample size of 433, Mohr-Sperduti [12] found that children with recurrent MEE showed an enduring shift in temperament. MEE was negatively associated with two dimensions of temperament: attention and difficult/fussiness.

Four studies did not find an association of MEE to attention or obtained mixed results [13-16]. It should be noted that sample sizes were small in these projects and they used different measures of attention from those that had positive results.

There is evidence that MEE and attention are related, particularly during the early years or during periods of active MEE. However, because of methodological issues, verification of a causal relation between MEE and attention remains inconclusive. Most of the retrospective and all of the prospective studies except the Mohr-Sperduti [12] study used small samples. Many of the samples involved special populations that were defined by socioeconomic status or clinical status. These studies used a variety of measures of attention, from rating scales to observational techniques and continuous performance tasks.

### 1.2 MEE and Behavior Problems

Four research groups have carried out prospective studies of MEE and behavior problems. Silva *et al.* [11] and Bennett *et al.* [17] found an association between MEE and behavior problems; but Roberts *et al.* [16] and Paradise *et al.* [18] did not. MEE assessment for the Bennett and Silva projects was conducted at 5 years of age and the Roberts and Paradise projects examined ears in the first 3 years. Silva assessed behavior problems at age 5 years and Bennett at age 10 years. Roberts assessed behavior problems at age 12 years and Paradise at age 4 years.

Although evidence is limited, results of some studies support the hypothesis that MEE is associated with the development of behavior problems. In addition to being few in number, these studies include populations of limited generalizability and small samples. The question of how MEE is related to behavior problems remains unresolved.

### 1.3 Attention

Although there is considerable agreement that attention plays a role in the development of behavior problems in children, research on the issue has been slowed by a lack

of consensus about the definition and measurement of attention [19]. Children with attention problems are noted to be inconsistent in their behavior over time or across situations in the performance of socialization, communicative, and self-care skills at age appropriate levels, despite generally average intelligence levels [20, 21]. One problem for researchers is that attention measures are only moderately stable over time [22,23]. Measures of inattention tend to be more stable than those of attention [23,24]. That attention is a complex and multifactorial process has led to the development of a wide range of measures. Mirsky [25] suggested that the multifaceted nature of attention and the different approaches often used to assess attention from study to study could account for the variability in outcome among studies of attention.

### 1.4 Attention and Behavior Problems

Research with children who have been referred for treatment of behavior problems, attention deficit disorder or learning disorders has found a consistent association between attention difficulties and behavior problems [26-31]. These studies tend to examine the relation between attention and behavior problems using concurrent assessment of the variables and to include samples of special populations and school-age children. We found no prospective studies of young children outside the clinical setting. We also found no studies of MEE, attention and behavior problems.

### 1.5 Research Hypotheses

Based on our review of the literature we formed two hypotheses: 1) attention difficulties are core factors in the development of child behavior problems, and attention is affected adversely by the hearing loss associated with persistent or intermittent MEE during the early years of childhood; 2) the relation of MEE and, therefore, attention, on behavior problems would exhibit a stronger effect at 3 years of age, a time when the child would more recently have experienced more MEE, than at 7 years. Improvement is expected because of the return of normal hearing as episodes become less frequent during the later preschool years. With advancing age, children have time for adaptation and previous deficits become less severe or disappear altogether.

Also this study examined whether duration of MEE was related directly to child behavior problems at ages 3 and 7 and to attention problems at these ages. Finally, we asked whether SES, home environment, or gender moderate the negative effect of MEE. For example, children with persistent MEE and low attention, but who are reared in positive and highly stimulating environments, may not develop more behavior problems due to the buffering effects of positive environmental stimulation.

## 2. Method

### 2.1 Sample

The study was part of a longitudinal study of middle ear effusion and its effects on child development. Infants ( $n = 698$ ) were recruited at birth from two hospital newborn nurseries in the Galveston and the near mainland Texas area. Only normal term infants were included. Low birthweight babies, babies with known neurological disorders and babies from families whose primary language was not English were excluded. Subjects were recruited while the mother and baby were still in one of the maternity units. Written informed consent from parents was obtained. Parents agreed to have a research assistant come to their homes on a frequent basis to check the child's ears and agreed to come into the research center for more psychological assessments during the first few years of their child's life. Parents were paid for their participation at each of the major assessments conducted at the research center at 2, 3, 5, and 7 years. The payment was \$35 early in the project was later raised to \$50. In almost all cases, these assessments occurred within 4 weeks of the child's birthday.

This project was approved by institutional review boards at both the University of Texas Medical Branch and the University of Houston.

### 2.2 Procedures

MEE status was assessed regularly from birth to 3 years. At 2, 3, 5, and 7 years, a battery of cognitive, language and behavioral assessments was administered to children at the research center at the University of Texas Medical Branch in Galveston. Examiners were four graduate students in psychology (3) and in speech communication disorders (1) who were especially trained in administration of the tests. Only children with normal hearing as indicated by audiometric testing carried out at the time of the examinations were tested. All children but one had normal hearing and this one was dropped from the study. Examiners were blind to the MEE condition of the children.

The participant's gender and ethnicity were obtained by parental report at the time of enrollment at birth. At 2 years, data on socioeconomic status (SES) and level of educational stimulation in the home environment were collected. Assessment of attention was obtained through parent report questionnaires at 2, 3, and 5 years. Examiner rating of attention occurred at 3, 5, and 7 years. At 7 years, a computerized continuous performance task assessed attention. Behavior problems were assessed with parent report questionnaires at 3, 5 and 7 years, and with teacher reports at 5 and 7 years.

### 2.3 Measures

Variables included in this study of children were MEE,

infant and young child attention, and young child emotional and behavioral problems. Control variables included gender, SES, and Home Observation of the Measured Environment (see below).

### 2.4 MEE

MEE status was defined as the presence of otitis media with effusion independent of other symptoms. Every 2 to 4 weeks from birth to 18 months and every 4 weeks from 18 to 36 months, scheduled visits at the home or daycare were conducted by trained technicians to monitor presence of MEE with tympanometry [3]. Acoustic reflectivity was measured at the initial 30% of the visits, but was replaced with tympanometry, which was performed at all visits. Diagnosis of MEE occurred if either ear met any of these criteria: (1) presence of otorrhea, or purulent pus draining from the ear canal visible without otoscopy; (2) acoustic reflectivity  $\geq 5$ ; or (3) a Type B tympanogram (*i.e.*, compliance of 0.0 or 0.1, or compliance of 0.2 or 0.3 only if the absolute gradient was  $< 0.1$  ml). For children with tympanostomy tubes, a diagnosis of MEE was made by the presence of purulent otorrhea or a Type B tympanogram in the presence of an external ear canal volume which indicates that the tube was not patent. At each home visit, both ears were evaluated by this criteria and categorized at either "normal" or "MEE". A computer-generated algorithm calculated the percentage of time each child spent with MEE for a given period (total days with MEE/total days in the examination period). To calculate time with MEE, two consecutive visits positive for MEE would equal 28 days with MEE. If only one visit of the two consecutive visits was positive for MEE, half of the intervening days (up to 14) were counted as days with MEE. This resulted in a maximum of 28 days of MEE was counted for any one MEE-positive visit [32]. Unilateral, bilateral or combined days of MEE were calculated. Parents were informed of the child's middle ear status and encouraged to see a physician if MEE was diagnosed. Duration of time and proportion of time spent with bilateral MEE was calculated for each child at 6, 12, 18, 24, and 36 months. The two measures were highly correlated and proportion of time was used for the analyses.

### 2.5 Attention

The strategy we adopted for the measurement of attention was to use four different measures that were age-appropriate; 1) parent ratings, 2) teacher rating, 3) examiner observation, and 4) computerized test.

Attention was assessed with parent report at 2, 3, and 5 years with the Task Orientation scale of the Revised Dimensions of Temperament Survey (DOTS-R) [33]. The alpha coefficient for preschool children was .79. At 3, 5, and 7 years, upon completing the cognitive assessment with the Stanford-Binet Intelligence Scale: Fourth Edi-

tion [34], examiners rated children's attention with two items on the Stanford-Binet for examiners' ratings of overall test performance: a) absorbed by task; and b) persistent. Examiners were trained by having pairs of examiners rate the same test-taking behavior. This was continued until ratings agreed 80% of the time. There was a follow-up repetition of this procedure to check on persistence of agreement. At 5 and 7 years, attention was assessed with parent report using the Attention scale of the Child Behavior Checklist for Ages 4-16 [35]. The Attention scale of the Teacher Report Form [36] was used to assess teacher-report of attention at 5 and 7 years.

At 7 years, attention was assessed by a computerized continuous performance test, the Test of Variables of Attention (TOVA) [37]. The 5-year-old test length of 11 minutes was used to save time in a lengthy battery of tests and because it was found to be highly correlated with the longer version. In addition, children found the longer version unbearably tedious. The test was always administered last. Four TOVA variables were used: 1) Errors of Omission or failure to respond to a target; 2) Errors of Commission or responding to the non-target; 3) Mean Correct Response Times; and 4) Variability, the standard deviations of response times. The occurrence of errors of omission was considered an indication of inattention whereas the occurrence of errors of commission was an indicator of impulsivity. Mean correct response time was an indicator of processing and response time. Variability relates to consistency in speed of responding.

## 2.6 Behavior Problems

Behavior problems were assessed by parent report at 3 years with the Child Behavior Checklist for Ages 2-3 (CBCL/2-3) [35] and at 5 and 7 years with the Child Behavior Checklist for Ages 4-16 (CBCL/4-16) [36]. At 5 and 7 years, teachers completed the Teacher's Report Form (TRF) [36]. Attention scale items are not included in either the Internalizing or Externalizing factors of the CBCL that are used as dependent variables. The Internal scale includes depression and anxiety and the External scale includes acting out disorders. One-week test-retest reliability for the Total Problems for the CBCL/2-3 was  $r = 0.91$  and for the CBCL/4-16 it was  $r = 0.93$ . The CBCL and TRF were used because they were measures most often used by behavior problem researchers and the measures are well-standardized and have good reliability and validity [35,36,38].

## 2.7 Moderating Variables

The Hollingshead Four-Factor Index of Social Status was used to assess family SES [39]. This index makes use of parental occupation and education. Educationally stimulating characteristics of the home environment were assessed with the Home Observation for Measurement of Environment Inventory (HOME) [40]. The mother was

interviewed and observed with her child in the home. The Total Score was used.

## 2.8 Reliabilities

All measures used had adequate reliability. Details may be found in the key manuals for each measure.

## 2.9 Statistical Analysis

Descriptive analyses of each variable were conducted. Bivariate correlations among all variables were computed. To test the overall hypothesized relation between MEE, attention and behavior problems, structural equation modeling (SEM) using LISREL 7 [41,42] was used. SEM was selected because of its ability to run multiple paths simultaneously and to test for possible networks of causality, using goodness of fit test for evaluation. Also, because SEM examines relations among latent variables, the errors in the indicators are eliminated giving more powerful tests of the hypotheses. See **Figure 1** for the hypothesized model. Only attention and behavior variables at 3 and 7 years were included, omitting data available at 5 years in the SEM. This was done to reduce the number of path estimates to compensate for the sample size, which was considered marginal for SEM. Goodness of fit indices and parameter estimates between the hypothesized model and comparison models were examined.

## 3. Results

From the initial sample of 698 recruited at birth, attrition occurred because families moved out of the research area or lost interest in participation and for various other reasons. One child was excluded after documentation of a sensory-neural hearing loss. The demographics for the sample initially recruited and at age 7 are as follows: female, 51% and 50%; African-American, 32% and 31%, Euro-American, 55% and 53%, and Hispanic, 14% and 16%; mothers married or co-habiting, 72% and 69%; Hollingshead Socioeconomic Status mean 37 (s. d., 13) and 37% (s. d. 13), and HOME mean, 39 (s. d. 5) and 39 (s. d. 5). Demographic characteristics of the sample remaining after attrition were very similar. Further evidence of the normal distribution of scores for this sample, and the normality of the sample, may be seen in the results for the Stanford-Binet Fourth Edition [34] administered to children at ages 3, 5 and 7. Their IQ scores were, 100.6 (SD = 12.2), 98.3 (12.6), and 98.0 (14.00), respectively, which are close to the normative sample IQ of 100.0 (SD = 15.0). Sample sizes at the evaluation time points were approximately 395 at age 2, 360 at age 3, 310 at age 5 and 200 at age 7.

We found no significant correlations between any of the MEE by time period and behavior problem scales. Correlations ranged from  $-0.14$  to  $0.11$ . Correlations between MEE and attention ratings were also low. Of 24

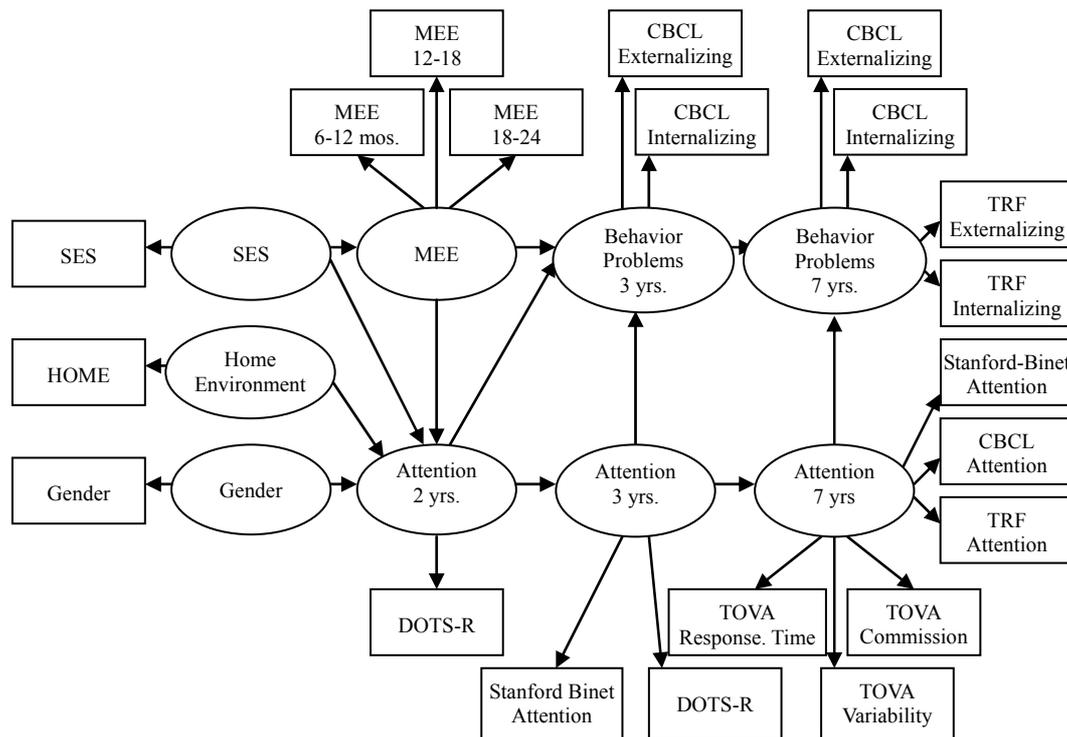


Figure 1. Hypothesized structural equation modeling

correlations, only two were significant. One was for Stanford-Binet-Attention (SB-Attn) and MEE,  $r = 0.14$ ,  $p < 0.05$ . MEE and continuous performance task (TOVA) correlations were non-significant for all TOVA measures except Variability. The significant MEE correlation with Variability was  $r = -0.21$ ,  $p < 0.01$ .

Attention ratings and behavior problems were significantly related. For the CBCL Externalizing, Internalizing and Total scores at age 3, five of six correlations with DOTS were significant (range:  $r = -0.14$  to  $-0.25$ ). None were significant at age 7. All 6 of the CBCL attention ratings at ages 5 and 7 were significantly related to CBCL scores at age 7 (range,  $r = 0.38$  to  $0.80$ ). None of the TOVA scores were related to CBCL scores at age 7. Using the CBCL Attention scale with a cut-off of 68 at age seven 4.4% of the children were found to have attention problems. The teacher version showed 4.5% with such problems. There were no gender differences.

For the primary inferential analysis, structural equation modeling (SEM) was used to test the adequacy of the theoretical model. SEM was selected because of its ability to run multiple paths simultaneously and to suggest a possible network of causal relations. The first step was model specification. Initial interest was in obtaining an adequate measurement model between the observed variables and the latent variables. However, the hypothesized measurement model could not be identified and major revisions were made before testing the structural model of relations between the latent variables. The first

step involved elimination of observed variables in order to increase covariances among variables within each construct. The SB-Attn at 3 and 7 years and the TOVA variables of Omission and Variability were eliminated. The latent variable for Attention at 7 years was divided into two separate latent variables. One consisted of CBCL and TRF Attention scales and the other consisted of the two remaining TOVA variables, Omission and Variability. In addition, SES and HOME were changed from estimating two separate latent variables to estimating one latent variable of environment. Lastly, the disturbance terms for CBCL Attention at 7 years and CBCL Externalizing at 7 years and for TRF Attention and TRF Externalizing were allowed to be correlated to account for method effects. These modifications did produce a workable model, but one that still did not meet measurement requirements according to the chi-square results. Additional changes were made based on examination of the fitted residuals and modification indices which lead to the removal of the observed variables, TRF and CBCL Internalizing at 7 years. The revised measurement model resulted in a large improvement in chi-square, goodness-of-fit and adjusted goodness-of-fit. The root mean square residual also decreased slightly. Any further changes would have resulted in major deviations from the hypothesized measurement model.

Once an adequate measurement model was established, the next step involved model identification and parameter estimation of the structural model based on maximum-

likelihood estimates from the covariance-variance matrix with pairwise deletion of missing values. Significance of parameter coefficients was based on the ratio of the statistic to its standard error, which are asymptotically normal. Z values < -2 and > 2 are considered significant. This model had direct effects from MEE to each of the latent endogenous variables. Home environment and gender also had direct effects on attention and behavior problem variables. However, no solution convergence was obtained. Parameters from the exogenous variables were redefined to allow a direct effect on each of the endogenous variables. This change resulted in model convergence.

The hypothesized structural model with parameter estimates is presented in **Figure 1**. A summary of the specification and fit indices for the hypothesized model is presented in **Table 1**. Regarding the primary research hypothesis that children with persistent MEE tend to have attention deficits and that deficits in attention result in more behavior problems, examination of parameter coefficients did not support that MEE has an effect on either attention or behavior problems. Between attention and behavior problems, there was one significant parameter estimate from Attention-A (CBCL and TRF) and Behavior Problems at 7 years. This finding also did not support a secondary research hypothesis that proposed stronger relations between MEE, attention, and behavior problems at 3 years than at 7 years. Lastly, regarding the

hypothesis that SES, home environment and gender would moderate the negative effect of MEE, several significant parameter estimates were found for Home Environment (SES and HOME) predicting behavior problems at 3 years and to deficits in Attention A (CBCL and TRF) at 7 years. In addition, significant parameter estimates were found from gender to both endogenous attention variables at 7 years. Significant relations are marked with asterisks (**Figure 2**).

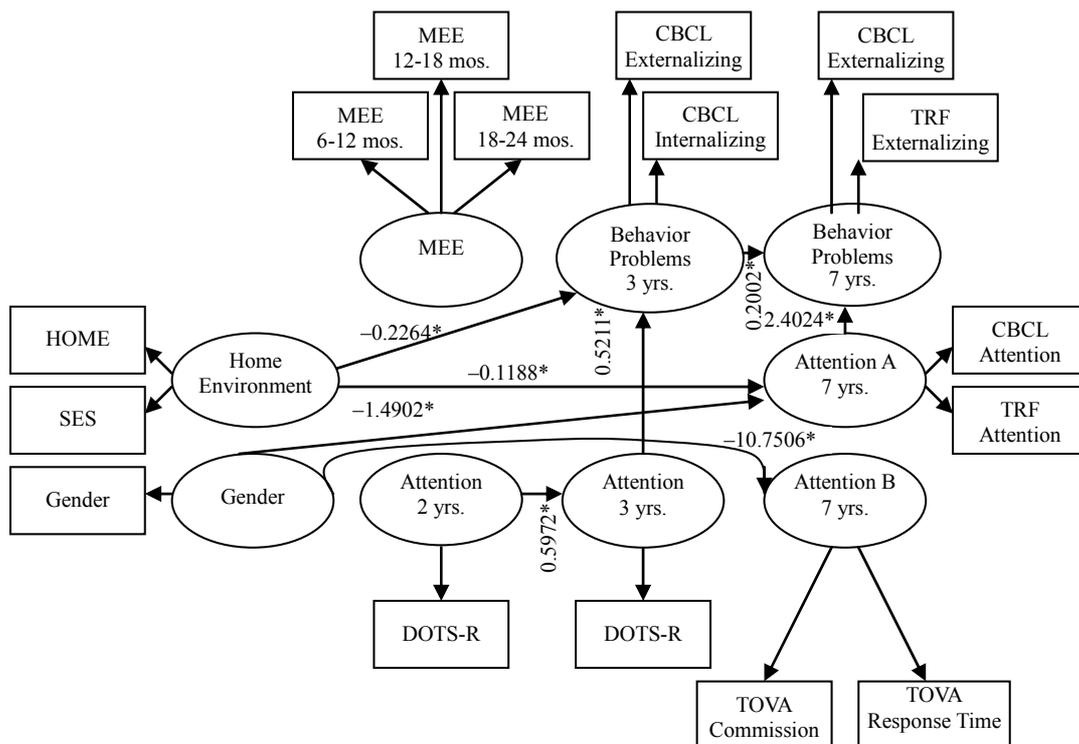
**4. Discussion**

This study provided a prospective examination of the impact of MEE on attention and behavior problems. It was hypothesized that a deficit in attention is a core fac-

**Table 1. Summary of specification and fit statistics for structural equation models of MEE, attention and behavior problems**

Measurement Model	$\chi^2$	df	p	GFI	AGFI	RMSEA
Revised Model A	235.77	93	0.00	0.8699	0.7608	0.0881
Revised Model B	75.10	69	0.2875	0.9434	0.8884	0.0157
Structural Model	$\chi^2$	df	p	GFI	AGFI	RMSEA
Hypothesized	84.4114	80	0.3464	0.9359	0.8910	0.0118
Comparison A	84.7454	82	0.3959	0.9355	0.8930	0.0041
Comparison B	85.4187	84	0.4363	0.9347	0.8943	0.0

Note: GFI = goodness of fit index; AGFI = adjusted goodness of fit index; RMSEA = root mean square error of approximation.



**Figure 2. Significant parameters for comparison structural equation: Model B**

tor that contributes to the development of a range of behavior problems and that attention is adversely affected by persistent MEE. Important strengths of the present study are its prospective design, early and regular monitoring of MEE, and selection of a large non-clinical sample representative of the general population. These characteristics contrast with those of the majority of studies using retrospective methods to investigate the relation of MEE to either attention or behavior problems [43]. Most had small samples [7-10,13-15,43-46]. Only a few studies relied on a large sample [11,12,18]. Often the samples were limited to low SES subjects [7,9,10,13,14,16], children with restricted SES representation [8], or to children referred for clinical evaluation [7,44]. Thus, this study provides an important perspective on the relations between MEE, attention, and behavior problems because of its methodological strengths.

The results of this study generally failed to support the hypothesis that children with greater duration of MEE experience greater attention deficits and more behavior problems than children with a shorter duration of MEE. SEM parameter estimates provided no support for the first hypothesis. Correlational analyses also did not support the hypothesis. Correlations between MEE and attention resulted only in association between examiner ratings of attention at 7 years and earlier MEE. Also TOVA Variability at 7 years was associated negatively with MEE, instead of positively, as expected. These two correlations were small and could be attributed to the increase of a Type I error due to familywise error. In addition, there were no significant associations between MEE and behavior problems, even at 3 years of age.

These results are consistent with those obtained by Roberts *et al.* [16] and Paradise *et al.* [18] who used prospective methods to identify duration of MEE in the first three years. Roberts *et al.* [18] found that duration of MEE was not related to number of behavior problems at 12 years of age. On the other hand, the present results contrast with those of Silva and associates [11], who did find persistent MEE to be related to more behavior problems. The Silva group used a cross-sectional method with behavior problems assessed at age 5. Having impaired hearing at that age was related to behavior problems and this relation was still present at ages 7, 9, and 11 [48].

The second hypothesis that attention mediates the effects of MEE on behavior problems was not supported. MEE was not related to either attention or behavior problems. However, some support was found for a relation between attention and behavior problems, excluding the role of MEE. Examination of individual parameters indicated that impaired attention at 7 years was related to behavior problems at 7 years, with both variables assessed by parent and teacher report. The second hypothe-

sis, which proposed that there would be stronger effects of MEE on behavior problems at age 3 than at age 7, was not supported. There were no effects at either age.

An important limitation of this study derived from the LISREL analysis that demonstrated a lack of association among variables within constructs and between the constructs. The originally hypothesized measurement model required significant revisions in order to get a solution to converge, resulting in a weak fitting measurement model. The small to moderate correlations among the measures of attention and behavior problems call into question the construct validity of the measures. Within attention measures, although some significant correlations were found across parent, teacher and examiner reports, these correlations were low.

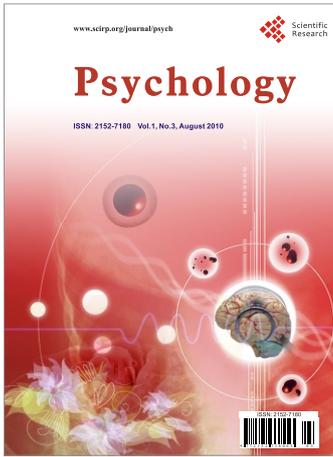
Given these methodological limitations, our results lead to the cautious conclusion that MEE in the first 3 years of life is not related to behavior problems that are present at ages 3 and 7.

## REFERENCES

- [1] K. A. Daly, "Definition and Epidemiology of Otitis Media," In: J. E. Roberts, I. F. Wallace and F. W. Henderson, Eds., *Otitis Media in Young Children: Medical, Developmental, and Educational Considerations*, Brookes Publishing, Baltimore, 1997.
- [2] G. A. Zielhuis, G. H. Rach, A. van den Bosch, *et al.*, "The Prevalence of Otitis Media with Effusion: A Critical Review of the Literature," *Clinical Otolaryngology*, Vol. 15, No. 3, 1990, pp. 283-288.
- [3] M. Owen, C. D. Baldwin, D. Luttmann, *et al.*, "The Universality of Otitis Media with Effusion Detected by Tympanometry on Frequent Home Visits in Galveston, Texas," *Proceedings of the 5th International Symposium on Recent Advances in Otitis Media*, Fort Lauderdale, 1993.
- [4] P. D. Eimas and J. F. Kavanagh, "Otitis Media, Hearing Loss, and Child Development: A NICHD Conference Summary," *Public Health Reports*, Vol. 101, No. 3, 1986, pp. 289-293.
- [5] D. P. McCormick, C. D. Baldwin, J. S. Klecan-Aker, *et al.*, "Association of Early Bilateral Middle Ear Effusion with Language at Age 5 Years," *Ambulatory Pediatrics*, Vol. 1, No. 2, 2001, pp. 87-90.
- [6] D. J. Lim, C. R. Bluestone, J. O. Klein, *et al.*, "Recent Advances in Otitis Media," Decker Periodicals, Philadelphia, 1993.
- [7] J. S. Gravel and I. F. Wallace, "Listening and Language at 4 Years of Age: Effects of Early Otitis Media," *Journal of Speech and Hearing Research*, Vol. 35, 1992, pp. 588-595.
- [8] L. V. Feagans, E. Kipp and I. Blood, "The Effects of Otitis Media on the Attention Skills of Day-Care-Attending Toddlers," *Developmental Psychology*, Vol. 30, No. 5, 1994, pp. 701-708.
- [9] L. V. Feagans, M. Sanyal, F. Henderson, *et al.*, "Rela-

- tionship of Middle Ear Disease in Early Childhood to Later Narrative and Attention Skills," *Journal of Pediatric Psychology*, Vol. 12, No. 4, 1987, pp. 581-594.
- [10] J. E. Roberts, M. R. Burchinal and F. Campbell, "Otitis Media in Early Childhood and Patterns of Intellectual Development and Later Academic Performance," *Journal of Pediatric Psychology*, Vol. 19, No. 3, 1994, pp. 347-367.
- [11] P. A. Silva, C. Kirkland, A. Simpson, *et al.*, "Some Developmental and Behavioral Problems Associated with Bilateral Otitis Media with Effusion," *Journal of Learning Disabilities*, Vol. 15, No. 7, 1982, pp. 417-421.
- [12] S. M. Sperduti, "A Structural Model for Otitis Media and Pain Effects on Attention and Difficult/Fussiness Factors of Temperament," Unpublished Masters Thesis, University of Houston, Houston, 1996.
- [13] E. Arcia and J. E. Roberts, "Otitis Media in Early Childhood and its Association with Sustained Attention in Structured Situations," *Behavioral Pediatrics*, Vol. 14, No. 3, 1993, pp. 181-183.
- [14] J. Kindig, "Otitis Media: Its Relationship with Delayed Reading and Attention Deficit Disorder," *Dissertation Abstracts International*, Vol. 56, 1996, p. 3520.
- [15] K. R. Minter, J. E. Roberts, S. R. Hooper, *et al.*, "Early Childhood Otitis Media in Relation to Children's Attention-Related Behavior in the First Six Years of Life," *Pediatrics*, Vol. 107, No. 5, 2001, pp. 1037-1042.
- [16] J. Roberts, M. R. Burchinal and S. M. Clarke-Klein, "Otitis Media in Early Childhood and Cognitive, Academic, and Behavior Outcomes at 12 Years of Age," *Journal of Pediatric Psychology*, Vol. 20, No. 5, 1995, pp. 645-660.
- [17] K. E. Bennett, M. P. Haggard, P. A. Silva, *et al.*, "Behaviour and Developmental Effects of Otitis Media with Effusion into the Teens," *Archives of Disease in Childhood*, Vol. 85, No. 2, 2001, pp. 91-95.
- [18] J. L. Paradise, C. A. Dollaghan, T. F. Campbell, *et al.*, "Otitis Media and Tympanostomy Tube Insertion during the First Three Years of Life: Developmental Outcomes at the Age of Four Years," *Pediatrics*, 2003, Vol. 112, No. 2, pp. 265-277.
- [19] M. K. Rothbart, M. L. Posner and K. L. Hershey, "Temperament, Attention and Developmental Psychopathology," In: D. Cicchetti and D. J. Cohen, Ed., *Developmental Psychopathology, Theory and Methods*, John Wiley, New York, Vol. 1, 1995, pp. 315-340.
- [20] R. A. Barkley, G. J. DuPaul and M. McMurray, "Comprehensive Evaluation of Attention Deficit Disorder with and without Hyperactivity as Defined by Research Criteria," *Journal of Consulting and Clinical Psychology*, Vol. 58, No. 6, 1990, pp. 775-789.
- [21] NJ Roizen, TA Blondis, M Irwin, *et al.*, "Adaptive Functioning in Children with Attention-Deficit Hyperactivity Disorder," *Archives of Pediatrics & Adolescent Medicine*, Vol. 148, No. 11, 1994, pp. 1137-1142.
- [22] R. J. McGowan, D. L. Johnson and S. E. Maxwell, "Relations between Infant Behavior Ratings and Concurrent and Subsequent Mental Test Scores," *Developmental Psychology*, Vol. 17, No. 5, 1981, pp. 542-533.
- [23] H. Ruff, K. Lawson, R. Parrinello, *et al.*, "Long-Term Stability of Individual Differences in Sustained Attention in the Early Years," *Child Development*, Vol. 61, No. 1, 1990, pp. 60-75.
- [24] C. M. Heinicke, S. D. Diskin, D. M. Ramsey-Klee, *et al.*, "Pre- and Post-Birth Antecedents of 2-Year-Old Attention, Capacity for Relationships and Verbal Expressiveness," *Developmental Psychology*, Vol. 22, No. 6, 1986, pp. 777-787.
- [25] A. F. Mirsky, "Behavioral and Psychophysiological Markers of Disordered Attention," *Environmental Health Perspectives*, Vol. 74, 1987, pp. 191-199.
- [26] S. B. Campbell, "Longitudinal Studies of Active and Aggressive Preschoolers: Individual Differences in Early Behavior and in Outcome," In: D. Cicchetti and S. L. Toth, Eds., *Rochester Symposium on Developmental Psychopathology: Internalizing and Externalizing Expressions of Dysfunction*, Erlbaum Group, Hillsdale, Vol. 2, 1991.
- [27] M. J. Eliason and L. C. Richman, "Behavior and Attention in LD Children," *Learning Disability Quarterly*, Vol. 11, 1988, pp. 360-369.
- [28] G. W. Rebok, W. E. Hawkins, P. Krener, *et al.*, "Effect of Concentration Problems on the Malleability of Children's Aggressive and Shy Behaviors," *Journal of the American Academy of Child and Adolescent Psychiatry*, Vol. 35, No. 2, 1996, pp. 193-203.
- [29] K. S. Lassiter, R. C. D'Amato, D. J. Raggio, *et al.*, "The Construct Specificity of the Continuous Performance Test: Does Inattention Relate to Behavior and Attachment?" *Developmental Neuropsychology*, Vol. 10, 1994, pp. 179-188.
- [30] M. A. Stein, E. Szumowski, T. A. Blondis, *et al.*, "Adaptive Skills Dysfunction in ADD and ADHD Children," *Journal of Child Psychology and Psychiatry*, Vol. 36, No. 4, 1995, pp. 663-670.
- [31] T. P. Zahn, M. Kruess and J. L. Rapoport, "Reaction Time Indices of Attention Deficits in Boys with Disruptive Behavior Disorders," *Journal of Abnormal Child Psychology*, Vol. 19, No. 2, 1991, pp. 233-252.
- [32] M. J. Owen, C. D. Baldwin and V. M. Howie, "Incidence and Duration of Otitis Media with Effusion during the First Two Years of Life," Paper Presented at: *Southern Society for Pediatric Research*, New Orleans, 4-5 February 1988.
- [33] R. M. Lerner, M. Palermo, A. Spiro, *et al.*, "Assessing the Dimensions of Temperamental Individuality across the Life Span: The Dimensions of Temperament Survey (DOTS)," *Child Development*, Vol. 53, No. 1, 1982, pp. 149-159.
- [34] R. L. Thorndike, E. P. Hagen and J. M. Sattler, "Stanford-Binet Intelligence Scale," 4th Edition, Riverside Publishing, Chicago, 1986.
- [35] T. M. Achenbach, "Manual for the Child Behavior Checklist/2-3 and 1992 Profile," University of Vermont Department of Psychiatry, Burlington, 1992.
- [36] T. M. Achenbach, "Manual for the Child Behavior Checklist/4-18 and 1991 Profile," University of Vermont Department of Psychiatry, Burlington, 1991.

- [37] T. M. Achenbach, "Manual for the Teacher's Report Form and 1991 Profile," University of Vermont Department of Psychiatry, Burlington, 1991.
- [38] T. R. Dupuy, D. McCarney and L. M. Greenberg, "T.O.V.A. Manual: Tests of Variables of Attention Computer Program. Version 6.0 for the IBM PC or IBM Compatible," Lawrence M. Greenberg, Minneapolis, 1990.
- [39] A. B. Hollingshead, "Hollingshead Four-Factor Index of Social Status," Department of Sociology, Yale University, New Haven, 1975.
- [40] B. M. Caldwell and R. H. Bradley, "Home Observation for Measurement of the Environment (Revised Edition)," University of Arkansas, Little Rock, 1984.
- [41] K. G. Joreskog and D. Sorbom, "LISREL 7: Estimation of Linear Structural Equation Systems by Maximum Likelihood Methods," National Educational Resources, Chicago, 1988.
- [42] D. Francis, "An Introduction to Structural Equation Models," *Journal of Clinical and Experimental Neuropsychology*, Vol. 10, No. 5, 1988, pp. 623-639.
- [43] T. Hubbard, J. L. Paradise, B. J. McWilliams, *et al.*, "Consequences of Unremitting Middle Ear Disease in Early Life: Otologic, Audiologic and Developmental Findings of Children with Cleft Palate," *New England Journal of Medicine*, Vol. 312, No. 24, 1985, pp. 1529-1534.
- [44] A. R. Adesman, L. A. Altshuler, P. H. Lipkin, *et al.*, "Otitis Media in Children with Learning Disabilities and in Children with Attention Deficit Disorder with Hyperactivity," *Pediatrics*, Vol. 85, No. 3, 1990, pp. 442-446.
- [45] K. Hoffman-Lawless, R. W. Keith and R. T. Cotton, "Auditory Processing Abilities in Children with Previous Middle Ear Effusion," *Annals of Otolaryngology, Rhinology and Laryngology*, Vol. 90, No. 5, 1981, pp. 543-545.
- [46] P. A. Silva, D. Chalmers and I. Stewart, "Some Audiological, Psychological, Educational and Behavioral Characteristics of Children with Bilateral Otitis Media with Effusion: A Longitudinal Study," *Journal of Learning Disabilities*, Vol. 19, No. 3, 1986, pp. 165-169.



# Call for Papers

## Psychology (PSYCH)

ISSN Print: 2152-7180 ISSN Online: 2152-7199

<http://www.scirp.org/journal/psych>

**PSYCH** is an international refereed journal dedicated to the latest advancement of Psychology. The goal of this journal is to keep a record of the state-of-the-art research and promote the research work in these fast moving areas.

### *Editor-in-Chief*

**Dr. Martin Drapeau** McGill University, Canada

### *Subject Coverage*

This journal invites original research and review papers that address the following issues in Psychology. Topics of interest include, but are not limited to:

Applied Cognitive Psychology	Occupational Health Psychology
Applied Gerontology	Professional Practice
Biological Foundation of Psychotherapy	Psychological Assessment & Evaluation
Clinical & Community Psychology	Psychology and Societal Development
Counseling Psychology	Psychotherapy approach
Critical Health Psychology	Psychotherapy for Different Mental Disorders
Economic Psychology	Sport Psychology
Environmental Psychology	Theory and Research in Psychotherapy
Ethics	Traffic Psychology
Health Psychology	Work & Organizational Psychology
Instructional & School Psychology	Others

We are also interested in short papers (letters) that clearly address a specific problem, and short survey or position papers that sketch the results or problems on a specific topic. Authors of selected short papers would be invited to write a regular paper on the same topic for future issues of the **PSYCH**.

### *Notes for Intending Authors*

Submitted papers should not have been previously published nor be currently under consideration for publication elsewhere. Paper submission will be handled electronically through the website. All papers are refereed through a peer review process. For more details about the submissions, please access the website.

### *Website and E-Mail*

<http://www.scirp.org/journal/psych>

E-mail: [psych@scirp.org](mailto:psych@scirp.org)

## TABLE OF CONTENTS

Volume 1 Number 3

August 2010

**Positive Development in Children and the Precursors of Healthy Life-Styles:**

**The Role of Eating Regularity and Level of Leisure Activity**

S. Ciairano, G. Bardaglio, E. Rabaglietti, M. F. Vacirca..... 151

**“Fun, Fun, Fun”: Types of Fun, Attitudes to Fun, and their Relation to Personality  
and Biographical Factors**

I. C. McManus, A. Furnham..... 159

**Life Events and Psychoeducation in Patients with Systemic Sclerosis**

Y. Chen, J.-Z. Huang, Y. Qiang, M.-M. Han, S.-C. Liu, C.-L. Cui..... 169

**Breakup Distress and Loss of Intimacy in University Students**

T. Field, M. Diego, M. Pelaez, O. Deeds, J. Delgado..... 173

**Communicating (and Responding to) Sexual Health Status: Reasons for STD (Non)  
Disclosure**

T. M. Emmers-Sommer, K. M. Warb, S. Passalacqua, A. Luciano..... 178

**Mapping the Self with Units of Culture**

L. H. Robertson..... 185

**Using Generalizability Theory to Evaluate the Applicability of a Serial Bayes Model in  
Estimating the Positive Predictive Value of Multiple Psychological or Medical Tests**

C. D. Kreiter..... 194

**Tolerance of the ERP Signatures of Unfamiliar versus Familiar Face Perception to  
Spatial Quantization of Facial Images**

L. Hanso, T. Bachmann, C. Murd..... 199

**Is a Divergent Central Serotonergic Activity Responsible for Either Despair or  
Learning Behavior in Intact Wistar or Sprague-Dawley CD Rats, Respectively?  
A Concomitant Behavioral and Electrochemical Analysis**

F. Crespi..... 209

**Middle Ear Effusion, Attention, and the Development of Child Behavior Problems**

J. Cross, D. L. Johnson, P. Swank, C. D. Baldwin, D. McCormick..... 220