Health-related quality of life in patients with cancer: From mean group measures to predictive individual indicator

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EA 4556 Epsylon Research Unit
Montpellier, France
www.lab-epsylon.fr
A research unit bridging health and human sciences

**Researchers**

- **Psychology**
  - n = 33 (73%)

- **Sport sciences**
  - n = 7 (16%)

- **Philosophy**
  - n = 1 (2%)

- **Medicine**
  - n = 4 (9%)

**170 members**

- 46 lecturers and full professors
- 5 clinicians
- 64 PhD students
- 6 post-docs
- 1 engineer
- 44 associates
- 3 admins

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Inter-individual variability

Discriminative function

$p < .05$

![Graph showing HRQL score comparison between Group A and Group B. Group B has a significantly higher score than Group A, indicated by the error bars and the p-value.]
Inter-individual variability

Evaluative function

![Graph showing the evaluative function with HRQL scores for Group A and Group B at admission and discharge.](image-url)
Explaining and forecasting?

Fast decliners (Kaplan et Ries, 2007)

$p < .05$

$p < .30$
Fatigue during breast cancer treatment: the worst symptom altering HRQL

(Stone et al., 2003)

Daily self-perceived fatigue during chemotherapy (Ninot et al., 2013)
Inter-individual approach

Theoretical aspects
- Classical law neglects time (Prigogine, 1994)
- HRQL level (attitudes + social stereotypes)

Methodological aspects
- Few repeated measures (< 6)
- Many subjects required (n > 100)
- Gaussian statistics

Psychometric aspects
- Long instruments (e.g., QLQC30 = 30 items)
- Weak sensitivity (e.g., likert scales < 6)
## Inter-individual approach

### Theoretical aspects

- Neglecting time
- Level

### Methodological aspects

- Few repeated measures
- Many subjects
- Gaussian statistics

### Psychometric aspects

- Long instruments
- Weak sensitivity

## Intra-individual approach

### Theoretical aspects

- Historicity (Nowak & Vallacher, 1998)
- Level + instability + dynamics
- Rate = product of a complex system

### Methodological aspects

- Best witness of self = self
- Time series analyses
- Cellular automata (Nowak et al., 2000)

### Psychometric aspects

- Brief instrument (Robins et al., 2001)
- High sensitivity (VAS)
Intra-individual variability

Individual daily change

Random fluctuations around a reference value ⇒ as a personality trait

Auto-correlation ⇒ NS  

\[(0, 0, 0) : y_t = \mu + \varepsilon_t\]  

White noise
Accumulation of random impacts ⇒ as a psychological state

Auto-correlation ⇒ $p < .05$  
$(0,1,0) : y_t = y_{t-1} + \epsilon_t$  
Brownian motion
Individual daily change

Relaxation oscillations around a fixed point attractor $\Rightarrow$ steady state

Auto-correlation $\Rightarrow p < .05 $ 

\( (1,0,0) + \text{cste} : y_t = \mu + \phi y_{t-1} + \varepsilon_t \)

Homeostasis
Random change around a local reference slowly evolving ⇒ dynamic balance

Auto-correlation ⇒ $p < .05$

$(0,1,1) \quad y_t = y_{t-1} - \theta \epsilon_{(t-1)} + \epsilon_t$  

Pink noise
Example of protocol design

**Instrument**
- Physical Self Inventory 6b (Ninot *et al.*, 2006; Fox and Corbin, 1989)

  *Globally, I have a good opinion of myself*

  Not at all  
  |-----------|  | Absolutely |
  | 6.5 cm    |  |

  - Random presentation of items
  - Measure error item
  - Personal zone of comment

**Experimental design**
- Self-assessment twice a day (7:00 – 9:00 AM and PM)

**Time series analysis**
- Auto-correlation, Autoregressive Integrated Moving Average, fractal analyses
Example of times series

A : Man, 31 years old

Time series of global self-esteem and measurement error item over a 6-month period (self-assessment twice a day, between 7:00 and 9:00, AM and PM)
Time series analysis: Auto-correlation function

- Dec Corr.
- ErrT

- Q
- p

Values:
- 10: +.491, .0515
- 20: +.272, .0508
- 30: +.023, .0501
- 40: -.106, .0493
- 50: -.191, .0485

Q values:
- 1219: 0.000
- 1697: 0.000
- 1783: 0.000
- 1806: 0.000
- 1937: 0.000
Time series analysis: Auto-correlation function
Time series of global self-esteem and measurement error item over a 6-month period (self-assessment twice a day, between 7:00 and 9:00, AM and PM)
Time series analysis: Auto-correlation function

<table>
<thead>
<tr>
<th>Decorr.</th>
<th>ErrorT</th>
</tr>
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<tbody>
<tr>
<td>0.683</td>
<td>0.0518</td>
</tr>
<tr>
<td>0.566</td>
<td>0.0510</td>
</tr>
<tr>
<td>0.473</td>
<td>0.0503</td>
</tr>
<tr>
<td>0.344</td>
<td>0.0495</td>
</tr>
<tr>
<td>0.207</td>
<td>0.0487</td>
</tr>
<tr>
<td>0.065</td>
<td>0.0479</td>
</tr>
<tr>
<td>0.023</td>
<td>0.0471</td>
</tr>
<tr>
<td>-0.096</td>
<td>0.0463</td>
</tr>
<tr>
<td>-0.134</td>
<td>0.0455</td>
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<tr>
<td>-0.228</td>
<td>0.0446</td>
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</table>

<table>
<thead>
<tr>
<th>Q</th>
<th>p</th>
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<tbody>
<tr>
<td>2022.</td>
<td>0.000</td>
</tr>
<tr>
<td>3458.</td>
<td>0.000</td>
</tr>
<tr>
<td>4476.</td>
<td>0.000</td>
</tr>
<tr>
<td>5195.</td>
<td>0.000</td>
</tr>
<tr>
<td>5494.</td>
<td>0.000</td>
</tr>
<tr>
<td>5577.</td>
<td>0.000</td>
</tr>
<tr>
<td>5579.</td>
<td>0.000</td>
</tr>
<tr>
<td>5596.</td>
<td>0.000</td>
</tr>
<tr>
<td>5661.</td>
<td>0.000</td>
</tr>
<tr>
<td>5842.</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Discussion: Auto-correlation function

**Instability** (SD, Range, ADM)

- Self-esteem > measure error item (Ninot *et al.*, 2004; 2005)
- Inter-individual difference = indicator (Kernis *et al.*, 1993; Nezlek, 2002)

**Historicity** (ACF)

- Short term historicity ⇒ continuity of self (Tap, 1980; Tesser *et al.*, 1996)
  ⇒ self-verification (Swann, 1990)
  ⇒ personality (McCrae & John, 1992)
ARIMA : ecological condition

<table>
<thead>
<tr>
<th></th>
<th>6 months</th>
<th>1 year</th>
<th>512 days (17mths)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>n</strong></td>
<td>8</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>364</td>
<td>728</td>
<td>1024</td>
</tr>
<tr>
<td><strong>ARIMA (0,1,1)</strong></td>
<td>8 / 8</td>
<td>48 / 48</td>
<td>24 / 24</td>
</tr>
</tbody>
</table>

ARIMA models obtained in adults ($p < .001$)
ARIMA : experimental condition

\[ (0,0,0) : y_t = \mu + \varepsilon_t \]

ARIMA model obtained in 8 adults \( (p < .001) \)
Moving average model ARIMA (0,1,1) without significant constant

\[ y_t = y_{t-1} - \theta \varepsilon_{t-1} + \varepsilon_t \]

Value at time \( t \)

Value at time \( t-1 \)

Perturbation at time \( t \)

Fraction of the perturbation at time \( t-1 \)

Mathematically: random variations around local value changing slowly
A local equilibrium around a slowly varying reference value

Dynamical adjustment (Ninot et al., 2004, 2005; Delignières et al., 2004)

\[ y_t = y_{t-1} - \theta \varepsilon_{(t-1)} + \varepsilon_t \]

Random event(s)

Adaptation to perturbation

Preservation

Balance (0.0 \( \Rightarrow \) 1.0)

Without significant constant

A local equilibrium around a slowly varying reference value
Dynamics

ARIMA:
- Same dynamics (0,1,1)
- Self-esteem evolves slowly under influence of life events
- \( \theta \) determines the balance between preservation and adaptation

Fractal analyses \( \Rightarrow \) 1/ \( f \) noise
- Ubiquitous phenomenon in biological systems
- Intrinsic properties of stability and resistance to perturbations
- Characteristic signature of adaptive, young and healthy systems

(West & Shlesinger, 1990)
(Schmidt et al., 1991)
(Haussdorf et al., 1991)
Clinically

1 - Detect very quickly HRQL alteration

Possible interpretations:
- Uninformed knowledge about cancer disease
- Untrained disease management (routine or acute situation)
- Presence of comorbidities and complications (depression, sleep trouble…)
- Low social support

Possible consequences:
- Increase of risk of exacerbation or aggravation
- Increase of unhealthy behaviors
- Appearance of new disease
- Deterioration of communications with clinicians, caregivers and close persons

(Ninot, 2013)
Clinically

2 - Debate with the team and personalize supportive care strategies

<table>
<thead>
<tr>
<th>Functional</th>
<th>Psychological</th>
<th>Relational</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment adjustment</td>
<td>- Complementary tests</td>
<td>- Social support</td>
</tr>
<tr>
<td>Concomitant drug</td>
<td>- Adherence to therapy</td>
<td>- Group support session</td>
</tr>
<tr>
<td>Complementary tests</td>
<td>- Disease management</td>
<td>- Disease management</td>
</tr>
<tr>
<td>Exercise</td>
<td>- Psychological intervention</td>
<td>- Local care network</td>
</tr>
<tr>
<td>Nutrition</td>
<td></td>
<td>- Patients associations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Social network</td>
</tr>
</tbody>
</table>
3 - Following treatment / care efficacy

Minimally Clinical Individual Change (MCID)

(Ninot, 2014)
4 - Accompanying a person with a chronic disease

- patient-reported outcomes will improve communication between clinician and patient, enabling a common understanding of the severity of the patient’s disease

(Ninot, 2014)
Clinically

5 - Therapeutic value of retrospective presentation?

(Monthuy-Blanc et al., 2008)
6 - With the help of electronic devices

- delivering personalized disease management message
- monitoring comprehensive cancer support care

(Ninot et al., 2010)
Conclusion

The 4 P’s of Medicine
Predictive, Personalized, Preemptive, and Participatory (Zerhouni, 2008)

HRQL and uncertainty for shared decision
Uncertainty (Leplège, 1999)

Dynamics of HRQL scores and related health behaviors
Case manager, serious game, E-Health, nutrition counseling…

A universal questionnaire?
Brief instrument repeatedly used to analyze, model and forecast (Ninot, 2014)
Engaging clinical use of VAS to follow dynamics of symptoms (Senesse et al., 2014)
Conclusion

**Intra-individual** (e.g., follow up)

**Inter-individual** (e.g., phase III, RCT)
L’efficacité des interventions non médicamenteuses
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A PSYCHOMETRIC TOOL FOR THE ASSESSMENT OF THE DYNAMICS OF THE PHYSICAL SELF
NINOT, G., FORTES, M. & DELIGNIERES, D.
E.A. "Sport, Performance, Health", Faculty of Sport Sciences, Montpellier, France

The Dynamic Adjustment of Physical Self in Adults
Grégory Ninot*, Marina Fortes, Didier Delignières, & Christophe Maïano
University of Montpellier I, France

The Dynamics of Self-Esteem in Adults Over a 6-Month Period: An Exploratory Study
GRÉGORY NINOT
MARINA FORTES
DIDIER DELIGNIERES
Laboratory Symbolic Processes for Health and Sport
University of Montpellier I, France

The Fractal Dynamics of Self-Esteem and Physical Self
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Marina Fortes, University of Montpellier I, France
Grégory Ninot, University of Montpellier I, France